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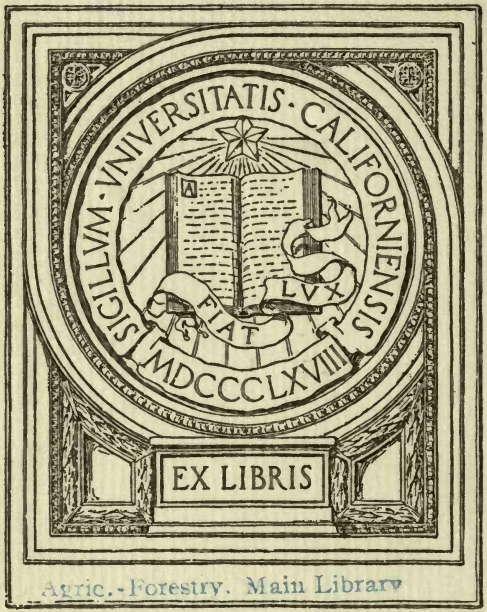

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FINLAND:

ITS FORESTS AND FOREST MANAGEMENT.

UNIV. OF CALIFORNIA

FINLAND:

ITS FORESTS AND FOREST MANAGEMENT.

COMPILED BY

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PREFACE.

THIS is the third of a series of Volumes, the publication of which has been undertaken as a contribution to the literature of Forest Science in the English language. The publication of the first of the series, *The Forests of England, and the Management of Them in Byegone Times*, resulted from the unexpected offer from a National Association to contribute £10 towards the expense, the Council of the Association having expressed the opinion that the successive publication of this and other Volumes of the series would certainly contribute to further the ends the Society had in view. When the proceeds of the sales of that Volume may suffice for the purpose, they will be spent in the publication of a companion Volume on the Management of English Forests in the Nineteenth Century, and their Present Condition, which is ready for the press.

In aid of the publication of the second of the series, *French Forest Ordinance of 1669; with Historical Sketch of Previous Treatment of Forests in France*, £10 were contributed by Mr W. T. Costigan, Montreal. When the proceeds of sales may suffice for the purpose, these will be spent in the publication of a companion Volume on Forestry and Sylviculture in France subsequent to the publication of the Ordinance of 1669, which also is ready for the press.

For the publication of this, the third of the series, the printer has, without departing from the usages of the

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trade, afforded facilities which are considered by me equivalent to a liberal pecuniary contribution. When the proceeds of sales from it may suffice for the purpose, they will be spent in the publication of a companion Volume on the Ethnography and Present Condition of the Finnish People, which is also ready for the press.

Meanwhile the printing of the fourth of the series has been begun. It relates to the Forests and Forestry of Northern Russia, and embodies details of the exploitation of forests by *Jardinage* and its effects.

The object aimed at is to produce popular technical treatises which may be useful to students of Forest Science who have not access to the works quoted, by stating views which have been advanced and have commanded attention, and by citing, or giving translations of statements bearing upon these, in such a form as to place readers in a position to work out for themselves a solution of problems raised, should they be so disposed.

I happened to spend the summer of 1879 in St. Petersburg, ministering in the British and American Chapel in that city, while the pastor sought relaxation for a few months at home. I was for years the minister of the congregation worshipping there, and I had subsequently repeatedly spent the summer among them in similar circumstances. I was at the time studying the Forestry of Europe; and I availed myself of opportunities afforded by my journey thither through Norway, Sweden, and Finland, by my stay in Russia, and by my return through Germany and France, to collect information bearing upon the enquiries in which I was engaged. On my return to Scotland I

contributed to the *Journal of Forestry* a series of papers which were afterwards reprinted under the title *Glances at the Forests of Northern Europe*. In the preface to this pamphlet I stated that in Denmark may be studied the remains of forests in pre-historic times; in Norway, luxuriant forests managed by each proprietor as seemeth good in his own eyes; in Sweden, sustained systematic endeavours to regulate the management of forests in accordance with the latest deliverances of modern science; in Finland, *Sartage* disappearing before the most advanced forest economy of the day; and in Russia, *Jardinage* in the north, merging into more scientific management in Central Russia, and *Réboisement* in the south.

The following pages may be considered a study of information I then collected, together with information which I previously possessed, or have subsequently obtained, in regard to the Forests and Forestry of Finland.

In a paper entitled *A British School of Forestry: Present Position of the Question*, which appeared in the *Journal of Forestry and Estate Management* in the issues of that magazine for April and May 1881, after stating what facilities for the study of Forest Science and of Practical Forestry exist, or might easily, and at little expense, be created in Britain, I remarked:—

'Should it be deemed desirable, as I think it is, that provision be made for still higher or more varied training being given to a select number of the more promising students, the desideratum can be met. In more than one of the most celebrated Schools of Forestry on the Continent provision is made for the attendance of foreigners, and these enjoy all the educational advantages of the alumni

on specified terms; and assuming that the teacher of botany—if there be but one—or one of them, if there be more, be qualified by knowledge of the language spoken, such advanced students might be sent under his direction to attend at one of these Continental Forest Schools a summer session, and possibly permission might be obtained from the same or some other School of Forestry for the British students to accompany the students of the country on their autumnal excursion, and to take part with them in the forest work, to the great advantage of teacher and taught, and through them of the country at large.'

It has been my design in the preparation of this Volume, and of the companion Volume on *The Forests and Forestry of Northern Russia*, to indicate matters of general interest included within the general course of study of Forest Science which might come under the attention of British students availing themselves of provisions for the prosecution of their studies such as I have thus suggested.

But while such has been my design in the preparation of the Volume, this had nothing to do with my selection of the subject of the treatise.

Dr A. Blomqvist, Director of the National School of Forestry at Evois, has done me the favour to peruse several of the following sheets since they have been printed, and to indicate some of the points in treating of which I have erred. He takes exception, on the ground of orthography, to the forms which I have given to several Finnish and Swedish names and words, and gladly would I avail myself of the emendations suggested by him, were this still practicable. Unhappily it is not so; but a few words of

apology and defence may be allowed me. Some of the forms I cannot justify—*Peccavi!* In other cases I have followed British usage: *Abo* is as defensible as is *Vienna;* further, the dipthongs "å" and "ä" are forms with which English readers are not acquainted, and I had to exercise my discretion in rendering words in which these occurred. I find that in doing so I have failed to maintain uniformity, which I now regret; and in other cases I have given in quotations the forms of names and words employed by the writers cited; but I do not suppose that in any case an English reader will be misled to anything like the extent to which he would be were he to give in France his English pronunciation of *Calais* or *Paris.*

Amongst those which I cannot defend is the form which I have given to the word *Svedjande* in some of the earlier sheets; this I have corrected on page 55, but I still find it more natural, both in speaking and in writing, to make use of the corrupted form. A more serious correction refers to the account I have given (p. 48) of the waterfall at Tammerfors, which shows that either I must have misunderstood my informant, or that he must have misunderstood the information communicated to him. Dr. Blomqvist informs me that there is not there a perpendicular water-fall 100 feet in height, but only a rapid.

Again, I have spoken of Finland as a Province of Russia. I am informed that it would have been more correct to have called it a Grand Duchy united to Russia. In Russia the term corresponding to "province" is *oblast;* but if we retranslate *oblast* into English, the synonym is not "province" but *territory,* as that term is employed in the United States,—an extensive region subject to law,

but not yet enjoying the rights of a State. In European Russia the whole country is divided into Governments, but in Siberia there are both Governors and Governor-Generals. Subject to the Governor-Generals, each *oblast* has its Governor and its capital, which ranks as a Government town. The *oblast* again is divided into *uyzeds*, each of which has its principal town, over which presides an Ispravnick; the *uyzeds* are divided into *vollosts;* and *vollosts* into villages with a church (*sello*), or hamlets (*derevnia*), if there be none. The chief man of a *vollost* is a *Zasidatil;* the chief man of a village is a *Starosta*, or alderman. It is alleged that an *oblast* is a territory the government of which is still being developed, while in a Government the government is determinate, the civil and military organisations being distinct. Now Finland is not such a province as is a Siberian *oblast;* and thus does importance attach to the distinction now made.

I further learn that the account I have given (p. 163) of the staff of teachers at the School of Forestry at Evois would require to be altered to make it correctly descriptive of the existing state of that Institution, and it was only in the editing of the first regulation of that Institute that Dr. Blomqvist acted as secretary to Mr Gylden, which requires a slight modification of a statement made on page 167.

In connection with the notice (p. 226) of Baron Rabbi Wrede having been Chief of the Administration of Forests from 1864 to 1870, it might have been stated that he was in 1859 appointed *adjoint ordinaire* to Mr Gylden in that office, and succeeded him as Chief (*Forst styrelsen*) in 1864, when that office was separated from the Department of Surveying (*Landmäteristyrelsen*), which office he held

as stated, till 1870. Baron Wrede took an active part in the organisation of the Finnish Forest Institutions, and he has ever showed himself a zealous friend to the practice of the most advanced Forest Economy of the day.

JOHN C. BROWN.

HADDINGTON, *1st September, 1883.*

———o———

AUTHORITIES CITED.

ASBJSERNSON, p. 11; BEDDAM, p. 81; BLANE, 74; BLOMQVIST, p. 56, 143, 163, 175, 178, 182, 188, 223; BUCHANAN, p. 63; CANNON, p. 78; CLEGHORN, p. 62, 77, 79, 86; *Cornhill Magazine*, p. 70; COSTA DE BASTELICA, p. 257; CRIGHTON, p. 193; DICK-LAUDER, p. 94; EMMERSON TENNANT, p. 68; FORBES, p. 76; *Frost and Fire*, p. 34, 265; GEIKIE, p. 26, 247; GOVERNMENT COMMISSIONERS, p. 112, 120, 122, 139, 199, 206, 209; GOVERNMENT D., p. 134, 150; GRIPPENBERG, p. 203; HANNIKAINEN, p. 226; HELMS, p. 45, 229, 233, 237, 242, 270; *Helsingfors Dagblad*, p. 209; HERSCHEL, p. 250; HOUGH, p. 168; IGNATIUS, p. 43, 52, 74, 181, 190, 205, 231, 234, 236, 239, 241, 244, 270, 279, 285, 288; INBERG, p. 274; JUDRAE, p. 13, 59; LAESTADIUS, p. 59; LORENTZ, 94; M'GREGOR, p. 73; MARSDEN, p. 68; MARSH, p. 71, 108; *Murray's Guide*, p. 28; NICOLSON, p. 19, 32, 209; PARADE, p. 62, 94; *Philadelphia Bulletin*, p. 254; RAMSAY, p. 247; REIN, p. 46, 56; SCHUBERT, p. 58; SIMOND, p. 261; WAHLROOS, p. 226.

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* Here and in some other places the word, through a mistake of the Author, subsequently observed, has been spelt *Sevanje*.

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THE FOREST LANDS AND FORESTRY OF FINLAND;

WITH NOTICES OF THE FINNISH PEOPLE.

PART I.

LAKES AND RIVERS OF FINLAND.

INTRODUCTION.

With Finland and its people I have been more or less extensively acquainted for fifty years. In the autumn of 1833 I went to Russia to undertake the pastoral charge of the British and American Congregational Church in St. Petersburg. The first evening I spent in that city was spent with a number of friends, Englishmen, Scotchmen, and Americans, who, by engaging in the sale and distribution of the sacred Scriptures and religious tracts in different languages, the support of a school for the children of poor foreigners, of a Dorcas Society for supplying the poor with clothing, of a Magdalene refuge for poor outcasts, and by other like philanthropic work, were seeking to do good; and in all these benevolent efforts they were encouraged by liberal contributions from the Emperor Nicholas, from the Empress, and from other members of the Imperial Family. The effects of their Christian work were felt from the Gulf of Bothnia to the Sea of Ochotsk, from Finland to Kamschatka. I was received with a brother-like welcome, and made welcome to co-operate with them to my heart's content.

In the prosecution of other works which devolved on me, I was enabled, with the co-operation and help of the late Dr Melartin, then Archbishop of Abo, and the encouragement of the Minister of State for the Grand Dutchy, to make arrangements for the publication of a new and corrected edition of the New Testament in Finnish, and for the supply of a copy of this at a low price, or if necessary gratuitously, to every family in Finland. This required returns of the population in every parish in the country.

During the last five-and-twenty years I have repeatedly spent the summer in St. Petersburg, preaching in the British and American Chapel, while one and another of my successors in the pastorate sought a few months' relaxation at home. And on almost all these occasions I visited some part or another of Finland.

With the knowledge thus acquired I consider I can best convey to another some idea of Finland, poetically designated by her people, "The Land of a Thousand Lakes," and "The Last-born Daughter of the Sea," by giving a sketch of a trip which I took to Kuopia, on the Saima See, in the summer of 1882.

By the middle of June most of the members of the church to which I was temporarily ministering had gone to the country for the summer, leaving little to be done by me excepting on the Sabbaths; and to this trip I devoted one of the intervening weeks.

CHAPTER I.

THE SAIMA SEE.

FROM the centre of St. Petersburg a small steamer conveys passengers to the Station of the Finnish railway. In doing so it passes through the most magnificent city-river-scenery in Europe, proceeding along a noble stretch of waters, deep and rapid in their flow, and ever filling their basins, the banks of which are lined with palaces, public buildings, gardens, and mansions, every one of which is itself a palace.

Taking departure from Vasilli Ostrof there are seen on the one bank of the river the English Quay—not a landing-place for goods and passengers from shipping, but a long street of elegant houses, amongst which is the Chapel of the British Factory, and the House of the English Club, with a low massive wall and broad pavement, both of red granite, said to have been brought from Scotland when the city was built. Landing-stages there are for small picturesque ferry-boats, and massive landing-places for firewood brought in barges from the interior; and there are moored barges elegantly fitted up for the sale of fresh-water fish of various kinds, kept alive in floating tanks till selected and delivered to the purchaser; but shipping there is none, excepting three or four richly gilt and beautifully shaped and equipped Imperial yachts, in keeping with the whole surroundings. Looking down the river we see large covered ship-building sheds, in which not a few of the wooden frigates of a former day were built. Along the quay from which we have started—the counterpart to that on the opposite bank, but bent in accordance with the bulging of the land, while the other is straight—are a

good many barges, coasting ships, and steamers, which partly conceal, but do not do so altogether, the Mining Corps and some other like commanding buildings. A-head of the steamer a little way is the Alexander Bridge.

Passing underneath one of the arches a new and magnificent view bursts upon us. On the left or larboard bow are seen the Academy, the University, the Exchange; a-head of these is the Fortress, with the lofty, beautiful spire of the Church dedicated to St. Peter and St. Paul, in the crypt of which are the tombs of the Emperors who have reigned since the founding of the city; and not far off, but not seen from the steamer, is the hut inhabited by Peter, while the palace afterwards inhabited by him and his successors, and the city which bears his name, were a-building.

Beyond the Exchange and the Fortress flows one of the numerous embouchures of the river designated the Little Neva, in contradistinction to the main stream, the Great Neva, separating Vasilli Ostrof from the city or the main-land, or what may be reckoned such. Beyond the Fortress is another embouchure, the Nevka, which afterwards bifurcates into the Great Nevka and the Little Nevka. A little above the branching off of the Nevka—on what may be described as a continuation of the right bank of the Nevka trending towards the middle of the main stream, the Neva—is a long stretch of white buildings, the School of Medicine with hospitals and other adjuncts; and in apparent continuation to these, but at an obtuse angle with the line of their frontage, is Nicholai Bridge, concealed from sight by the somewhat concave opposite bank of the Neva. The breadth of the river throughout the stretch from the Exchange, at which the Little Neva takes its departure, to the School of Medicine on the inclination of the bank of the Neva, the prolongation of which is the right bank of the Nevka, is magnificent. There are, besides the permanent bridges mentioned, two Pontoon Bridges, which serve to vary the scene.

In keeping with all that is to be seen on the larboard

bow of the steamer is all that is to be seen on the starboard bow as she advances up the river. Emerging from the arch of the first bridge, it is found that what has been seen of the English Quay is little more than half of the entire length of that.

The upper half, not less imposing than that below, terminates in the Senate-House, with its frontage at right angles to the quay; and in continuation with that frontage, separated only by a lofty arch spanning the Galernoy Street, but forming part of the façade of the building in its entirety, is the House of Assembly of the Holy Synod, with pertaining offices, the frontage of which is the counterpart to that of the Senate-House.

From these extend through what was formerly known as the St. Isaac's Plain, the Alexandra Gardens, enclosed in which, in the corner nearest to the Senate-House, is the famous equestrian statue of Peter the Great on an immense granite boulder. Beyond this, at right angles to the Senate-House, and that of the Holy Synod, is St. Isaac's Church.

Parallel to the river is the Admiralty, with a tapering spire covered with gold; and beyond it, at the commencement of what, on the same principle which procured for the English Quay its name, has been named the Russian Quay, is the Winter Palace, and the Hermitage, both of them opposite to the origin of the Little Neva, and looking out upon the stretch of river spoken of as magnificent in its breadth. In passing the wide space between the Admiralty and the Winter Palace, a glimpse may have been obtained of the summit, at least, of a lofty monolith, surmounted by an angel holding a cross, dedicated to the memory of Alexander I. Amongst the palatal mansions beyond the Hermitage are the Marble Palace, the Mansion of one of the Grand Dukes, and the British Embassy. Amongst open spaces are the Champ de Mars, with a statue of Kutusoff; and the Summer Gardens, the avenues of which are lined with statuary, and within sight from them is the Nicholai Bridge.

It is throughout the most magnificent city-river-scenery I have seen ; nor is it devoid of historical associations. The Fortress, like the Tower of London, is the State prison of the metropolis.

In the Winter Palace, Catherine II., known as Catherine the Great, held her Court. It faces St. Isaac's Plain, the scene of the military insurrection which occurred when Nicholas ascended the throne ; and adjacent to it, standing on the plain, is Alexander's Pillar, of which mention has been made, a monolith erected and dedicated to the memory of Alexander I.

At the main entrance to the Summer Gardens is a large elegant shrine, with *obratzes* or sacred pictures, and ever-burning lamps, erected on a spot on which Alexander II. was fired at by an assassin.

In an upper corner of the Winter Gardens stands the first palace of Peter the Great, to which he removed from the hut in which he lived while it was being built.

Beyond, but within sight of these, is the noble bridge, leading to what is called the Finnish side, and within a quarter of a mile from this bridge is the station, the terminal station of the Finnish railway, a little way from the landing place. From this the passenger must walk ; but by tramway car or other conveyance the station may be reached from almost any part of the city.

For several miles the Finnish railway passes on the one side a far-stretching successions of villas, the summer residences of hundreds, I may venture to say of thousands, of the well-to-do inhabitants of St. Petersburg ; on the other it passes stretches of forests of birch and pine, and of level land strewn with boulders of various bulk; and on both sides, interspersed with these are cabbage-gardens and fields of strawberries. Beyond these, the villas and gardens give place to the dominating forests and boulder-strewn land, upon which are seen patches of rye, and of potatoes, and oats.

A journey of about four hours brings the traveller to Wyborg, a town of some 13,000 or 14,000 inhabitants, seventy-five miles distant from the capital. I visited Wyborg in 1860, and returning now after an interval of two-and-twenty years, it appeared to me greatly improved.

According to Murray: 'The port of Wyborg is of great extent, is enclosed by two large islands, which act as breakwaters. The town is about eight miles from the harbour, at the end of a large bay. There are there ruins of a castle built in 1293 by the brave Torkel Kuntian, one of the most illustrious Swedes mentioned in history. It was destroyed by fire; the upper stories are roofless, the lower ones are used as a prison. The old fortifications, of which only a rampart remains, date from the fifteenth century. In 1710 the place was besieged by Peter the Great, and taken after a hard struggle of several weeks. The peace of 1721 put the Tzar in definite possession, and in 1743 the treaty of Abo enlarged still further the conquest.'

From Wyborg, the traveller may proceed either by land or by canal to the Saima Lake, visiting by the way in either case, if so disposed, the Falls of Imatra, by which the waters of that inland sea find their way to Lake Ladoga, and thence by the Neva to the Baltic and the ocean beyond.

The Saima Lake, according to one more restricted application of the name, is some 60 versts, or 40 miles, long, and 30 versts, or 20 miles, broad; according to another more extended application of the name, the length, in the direction west-south-west and east-south-east, is said to be 130 versts, or upwards of 86 miles, and the breadth from north to south is 120 versts, or 80 miles. But in either case it is applied to what is only the lower part of an immense inland expanse of water, extending some 400 versts, or 235 miles, in length, and covering an area of some 6000 square versts, or 4000 square miles. The difference

of altitude between this and that of the Gulf of Finland is 256 feet, and there is a valley in which is a chain of connected lakelets, which, though not the outlet by which its waters find their way to the ocean, has been utilised as a channel of communication with the sea by means of twenty-eight locks built of granite, which there abounds. The canal was constructed for the Government by Erichson, a Swedish engineer, at a cost of about £400,000 It was opened in 1856; and honour has been done to all men of distinction connected with the accomplishment of the undertaking, engineer and emperors—for it was begun in the reign of Nicholas, and completed in that of Alexander II.—statesmen and patriots, by inscriptions in brass on monuments of granite, giving their name, their rank, and a brief statement of their achievements. These monuments vary in shape, and one or more are placed at every lock along the line, each commemorative of some one hero who had contributed to the execution of the work.

In proceeding by the canal from Wyborg to Wilmanstrand, we pass from lake to lake in a continuous chain, like that of the lakes of North America; sometimes advancing towards the richly-wooded head of a lake, where further progress may be thought to be impossible, but before the prow of the steamer can reach the shore, a small outlet in a corner is seen, and traversing this, in a few minutes we find ourselves in another lake still more spacious. At length we enter the lower portion of the Saima See, and sail through thousands of islands, for, it may be, a hundred miles, and entering the upper portion of it, we find that the thousand islands have given place to a thousand lakes, not in continuous line, but confined in a net-work of wooded ridges, and branching off on the right hand and the left, backwards and forwards, hither and thither, and everywhither.

The Saima Canal has a minimum depth of $8\frac{3}{4}$ feet, and a minimum breadth of $31\frac{1}{2}$ feet, so vessels of tolerable size, drawing not more than $6\frac{1}{2}$ feet, can navigate it with safety.

When I passed through it we met at one of the locks a large Imperial yacht, in which the Grand Duke Alexis had been making the tour of the lakes. I thought, as I advanced further and further on my voyage, that were the characteristics of the Saima Lake and the Saima See better known, hundreds of British and American tourists and owners of yachts would do the same.

In Finland one hears as often, I think, of the Saima See as the Saima Lake. The former designation I understand to be applied to the whole body of connected lakes and lakelets.

The lower part of this sea, to which the designation Saima Lake appears to me to be confined, is studded thick with islands of all shapes and sizes, from that of a small dining-table to an area of miles; all of them wooded to the water-edge. I have elsewhere had occasion to tell of the islands clustering around the Norwegian coast, as these were seen by me, in sailing from Christiansand to Christiana:

'I was reminded of a voyage through the thousand isles of Lake Ontario; but the scene was different. Here the islands are rocks, but not rocks rough and rugged—rocks of granite plained down and smoothed by glacial action, more like clean and white and sparkling banks of mud than are rocks on a sea-girt shore. It required no effort, and but little fancy, to picture them as an ocean-bed rising above the sea, when, according to the Hebrew cosmogony, God said, "Let the waters under the heavens be gathered together, and let the dry land appear." And again, "Let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit after his kind: and it was so."

'There, were the bare rounded granite rocks, without a blade of vegetation; there, were others with only a lichen or a moss, or a grassy or flowery green spot. The former was on the dry rock, the latter on any crack or hollowed basin; and there, where there was a wider rent, or a cup-like basin containing a handful of earth, a sapling

tree; and there, an island not much larger, covered with trees to the water's edge; and there, larger islands, or the mainland, with high rising hills clothed with wood and forest beyond. Again and again I felt that day as if I were alone with God, or rather with His work, as His work is described by Wisdom in the Book of Proverbs: "When there were no depths, I was brought forth; when there were no fountains abounding with water. Before the mountains were settled, before the hills was I brought forth: while as yet He had not made the earth, nor the fields, nor the highest part of the dust of the world. When He prepared the heavens: when He set a compass upon the face of the depth: when He established the clouds above: when He strengthened the fountains of the deep: when He gave to the sea His decree, that the waters would not pass His commandment: when He appointed the foundations of the earth."

'The effect was heightened by the general absence of animal life, excepting at the towns and villages. Once or twice a cow was seen, once or twice a bird on the wing, and once a realisation of Kingsley's picture of the sea-gull on the all-alone stone, far out at sea! This was as we left the islands, shortly after noon. There were four gulls struggling to maintain their footing on a little projecting rock far out at sea, washed over by a wave produced by our passing vessel. And here and there a solitary house — neat, painted, and clean — might be seen; or an island, where road there was none but the highway of the sea, as if men were only beginning to appear upon the earth.'

Here, the islands were covered with arborescent vegetation. Trees seem to grow as naturally in Finland as grass does elsewhere. One Finnish gentleman speaking to me of the land, in the neighbourhood of Wyborg, said to me, 'It has been so impoverished by culture that it won't bear trees, and only produces grass.' I may differ from him in his reasoning on the phenomena referred to,

but I accept his statement as an appropriate illustration of the rich luxuriance of forest vegetation in the regions of the Saima See.

The scenery here, as did that in the south of Norway, reminded me forcibly of that of the thousand isles in the mouth of Lake Ontario; but here they were more widely separated, and apparently more numerous by far. They suggested the somewhat gross conception of the thousand isles in the Lake Ontario appearing as if they had been washed away from all parts of the lake, and accumulated at the outlet, stopping the further progress of each and of all, while here every island seemed as if it had maintained its footing and kept its place as it first rose above the watery plain. There are wide spaces between the islands surrounding the voyager everywhere, and the course for navigation from one place to another is marked out by beacons and *broomsticks*, the former on islands, the latter on shoals. The beacons are compactly built heaps of stones, kept white-washed, surmounted often by poles bearing different devices, such as stars, square and compasses, triangles, and arrow-heads, by which the exact locality of the steamer can be known. On my return voyage from the upper part of the sea I sailed upwards of 200 miles in a small yacht-like steamer of 35 tons, and 25 horse-power, with every convenience on board, steaming at an average rate of upwards 10 miles an hour; and I was informed by the captain that there were upwards of a hundred and fifty such like small steamers, plying about on the lake, threading their way amidst the islands everywhere, besides tug-steamers towing vessels laden with wood. The abundance of fuel, and the great manufacture of such tiny steamers, of which several engineering firms in Finland, as in Sweden, have made a special industry, have entirely superseded, or almost entirely superseded, sailing boats, excepting small boats belonging to the peasants, used as a means of conveyance from farm to farm, and from farm to market, and in prosecuting fishing. Landed proprietors have small steam-launches.

After some twelve hours steaming through among these numerous and multiform richly-wooded isles, all of them picturesque and beautiful, we reached Nyslot, which is situated at a point which marks the connection between the lower and the upper portion of the lake, or system of lakes.

Nyslot, or Newcastle, according to Murray, apparently must have taken its name from the outer works surrounding an old castle on a small island adjacent to the tower, built in 1475. Nyslot was ceded to Russia by the treaty of Abo, and the outer works, the ruins of which remain, were constructed by Saranoff, in expectation of a war with Sweden. In 1788 the castle was blockaded by the Swedes, but not taken. The two principal towers of the castle are severally called Kirch and Koch, and the former was frequently used as a State prison. Skeletons with chains attached to them were found some years ago in the ruins of the walls, supposed to be remains of prisoners who had been immured. The tower is situated on a promontory in the narrow strait between the two principal basins of the Saima See. It attracts many visitors, who come hither to enjoy the beautiful views which open out in every direction. Here are situated extensive saw mills, the *Nyslot Säg*, or *Savolinner Salia*, belonging to Messrs Hood & Co., of London.

At Nyslot we pass from what is known as the Saima Lake, and enter on the upper series of lakes connected with it, and connected with others bearing different names, but not always separated by well-defined manifest boundaries. Amongst others of these upper northern lakes are Lake Kallavesi, upon a peninsula projecting into which is situated the town of Kuopia; and the lakes Paapavesi, Haukivesi, Pihlagavesi, Puruvesi, and Pielisjaervi. The last-named is about 75 miles in length from north-west to south-east, and 15 miles in extreme breadth. On its south bank is the town of Eno, about 90 miles east

of Kuopia. From the south bank issues the river Pielis, conveying its waters into Lake Orivesi. Lake Puruvesi is situated to the south of Orivesi. It is 24 miles long from north-east to south-west, and 18 miles in breadth.

A little below Nyslot we met two Finnish timber-rafts containing each, it was estimated by a Finnish gentleman, about 5000 logs; and above Nyslot other two containing, according to the estimate of a Finnish engineer engaged extensively in the manufacture of machinery for saw-mills and other purposes in Nyslot, 10,000 logs each. I have called these *Finnish* timber-rafts. The movement of all the Finnish timber-rafts seen by me on the Saima See was effected by a boat carrying out an anchor to a considerable distance a-head, and the raft being warpt thither by a windlass on the raft, to which motion was given by a horse on board. The men had on board a fire for cooking, and a small hut for shelter. The largest rafts were destined for Messrs Hood & Co.'s saw-mill at Nyslot.

In regard to the form of the raft which is known in Northern Russia, if not also here, as the *koshell*, M. Judrae, a distinguished Member of the Imperial Forest Service in Russsia, gives the following information:—

'Up to 1860, logs designed for floatage on the lake were generally made up into rafts at considerable expense; but in 1861, a peasant, a native of Finland, devised the system of floatage in the so-called *koshell*. These *koshells* are of two kinds, designed respectively for transit by lake and by sea. The former are of a less complicated structure than the latter. The lake *koshell* consists of two parts, a head and a body. The head is a simple raft of logs of ordinary size, one row deep. On this the navigators take their places, and sometimes horses, together with a windlass or other machinery for winding up rope to which an anchor is attached. The head is formed of logs arranged lengthwise in a regular row, the number varying with the intended size of the *koshell*. It goes foremost, and

on it the moving person operates. To the left side of the head there is attached a string of logs, joined end to end, where they are hewn thin, and through a hole about an inch in diameter they are tied together with twigs twisted like a rope, each end of this being twisted or tied up into a knot not likely to slip. One log is thus added to another, and thus with another and another, until a sufficient length has been prepared. When the last is attached to the right side of the head and there is formed an extensive loop or circle of connected logs—a chain, of which these are the links. This is called the body of the *koshell*, and into the interior of this circle are tumbled, without any determined order, the logs which are to be floated away. Into these lake *koshells* there are put from 4000 to 8000 or 10,000 logs; and sometimes, as a prevention against rupture in a storm, there is superadded to the encompassing chain of logs a thick rope.

'The *sea koshell* differs somewhat from the *lake koshell*. The head consists not of one layer, but of several layers of logs, either laid in alternate directions, or, if all be in one direction, bound very firmly by cross logs. Short logs are generally employed, the so-called seven *archine* logs, about 16 feet long. What is of first importance in these is their power of resistance, as they are frequently subjected to the strain of severe storms, and in view of this, the logs in the body of the *koshell* are all laid in regular rows. The first row following the head may consist of 45 logs, the second of 50, the third of 60, and so on, increasing till the row in the middle of the body may consist of 150 logs, after which the number in each successive row diminishes, till the body presents the outline of a lengthened ellipsis. Besides this, in several places the ends of the body are connected by means of logs fastened across them, so as to keep the *koshell* more compact. *Koshells* formed thus can withstand very severe storms. They may contain from 1200 to 3000 logs, but not more.

'Such *koshells* are generally towed by steamers; and to show how much cheaper the floatage of timber by *koshells*

than the floatage by rafts or single logs, and how much the first proprietor or the wood merchant gains in profit from this contrivance of the Finnish peasant, though it is not very easy to do so completely, I may state the following particulars: In the floating of timber on the Mat Kosero by the old system, the log of timber costs about five kopecs; now, by floating it in these *koshells* it costs about one and one-half kopec, or less than one-third of the former cost. The bringing of timber to the Koumsa saw-mill, in consequence of this new method of floatage, costs, for each log, about thirty kopecs less than it did formerly. If we assume that the transport of each log to the saw-mills in the Government of Olonetz costs, upon an average, ten kopecs less than it used to do; and if we take 237,000 —the number of logs cut up by these saw-mills in 1865— as the average annual number, then it will be apparent that the saving of expense will be 23,700 roubles, or £2370, per annum. Such results have followed this so-called trifling contrivance. The name of the peasant has not been made famous; but it is said that he is now a very rich man, and the other peasants speak of him as a very knowing one.'

Between the lower lake on which Nyslot is situated, and the higher lying lakes or basins of the Saima Lake system, are two canals, with locks, connecting successive series of these. Near Taipola, where is one of these canals with two locks, are the iron-works of Warkaus.

Finland, as I have stated, is poetically known in the country as "The land of a thousand lakes," and as "The last-born daughter of the sea." In travelling you continually come upon beautiful lakes of great and small dimensions embedded in woods, such as may be seen in the immediate vicinity of St. Petersburg, at Schuvalova, Ejora, and Ukie; but the upper portions of the Saiman See, for it bifurcates towards the north, gives to the visitor another idea altogether of what is implied in the designation, "The land of a thousand lakes."

The difference between the appearance presented by the lower portion, and that presented by the upper portion of the See, is occasioned by a difference in the relative altitude of the land and water. In the portion now under consideration, the ridges connecting higher elevations of land are above the level of the water, in the region previously described, these are covered by the lake, and only the projecting elevations of the land appears above the surface, as islands innumerable.

The depth of the lake varies, as may be supposed, greatly. In the channel navigated it is at places 10, 12, 20, and even 60 fathoms or more, while there are necks, subaqueous hills and plains, forming shoals, covered by less than 6 feet of water.

In winter the whole is covered with one continuous sheet of ice, 1, 2, 3, and 4 feet in thickness, while the snow covers land and water with a fleecy mantle 2, 4, and 6 feet in thickness; and the trees everywhere present a beautiful but sometimes somewhat grotesque appearance, from their being covered with a thick dress of frost-work on every branch and spray. The dead level of the frozen water is then covered with a beautifully laid table-cloth of snow, smooth, clean, and white; at some places the effect of the wind sweeping over the plain may be seen, but even where it has cleared the ice of its covering, the beautiful sweep of the curve is unbroken, on the island the snow accumulates among the trees to a depth of, say, five feet. Above this sometimes may be seen every twig sustaining what looks like a slice of fleecy snow, two inches thick, but more frequently every twig of birch, and every needle like leaf of the pine and the fir, sparkles in the moonlight or the sunshine, as if covered with jewels, diamonds, rubies, emeralds and pearls; and, in many cases, the trees thus bedecked, appearing like a cluster of fountains rising high from some placid basin, reminding one of all that may have been read in boyhood of the

wondrous appearance of the Geysers of Iceland: frozen Geysers these, arrested by the frost, as they are said to be caught by the instantaneous glance of the camera of the photographer!

At the time of my visit—the leafy month of June—all was verdant, but the verdure was not of an uniform tint. Directing the attention of two of my fellow-voyagers in these upper reaches—the one a landed proprietor in the district, the other the factor or head manager of extensive estates there—to the comparatively young appearance of the trees on the shore, and asking them what was the cause of this, both at once said it was a consequence of the practice of *Sevanje*.

I shall afterwards discuss at some length this mode of treating forests, to extend my acquaintance with which was one of my purposes in seeking to make myself acquainted with the forestry of Finland. It may suffice here to state that it consists in burning down a portion of forest, and for two, three, or more years, sowing the charred ground with cereals; then when the crops produced cease to be satisfactory, clearing in the same way another portion of forest, and treating the charred ground in a like manner.

It is practised extensively in the north of Europe. In Sweden it is also called *Sevanje;* in France it is known as *Sartage;* in India as *Koomaree*. My fellow-travellers pointed out to me how might be distinguished different spots within sight, some burnt over by accidental fires, others shortly before subjected to this operation, others recovering from having been so treated some twenty or thirty years before, and others untouched virgin forests.

From these gentlemen I learned that in that district, and also elsewhere on similar islands and wooded coasts in Finland, accidental fires are frequently occasioned by fishermen landing, kindling a fire to cook their victuals, and carelessly leaving this unextinguished. Those who kindle fires either thus or in connection with the practice of *Sevanje*, are pecuniarily responsible for all consequences,

including the destruction of forests; and other penalties are incurred by their carelessness. The damages are likely to be exacted when there is some probability of payment being obtained; but it appeared to me that the landed proprietors did not really care to do much in the matter, as though forests are more profitable than is regular agriculture, some compensation might be obtained by a few years crops from the cleared ground; and thereafter the trees would grow again.

To extinguish forest fires there are adopted the usual plans of beating with boughs the fire advancing in the grass, cutting lanes, across which the fire may be unable to spread, and burning a small portion of forest in advance of the conflagration, keeping the new fire under control, and extinguishing it when a small space has been cleared.

According to one informant, after a forest had been burnt, the same kind or kinds of trees as had grown there before spring up rapidly; according to another informant, the new crop was generally birch. I consider both reports correct, each in regard to the district in which my informant resided.

When a forest is to be burnt for *Sevanje* or *Sartage*, if there be any valuable trees there, these are first felled and removed. In no case is any provision made for the reproduction of the forest, this is left entirely to nature.

Towards nightfall we reached Kuopia, which stands on the shore of Lake Kalaawesi. It is a large but uninteresting town, with a population of 5600 inhabitants. It was founded in 1776. There is a pretty park on an island of Lake Wăppita Niemi; and a fine view of the surrounding lake-scenery may be obtained from the Observatory on Pujehill, about four versts, well nigh three miles, from the town, but which, in the clear atmosphere, appears to be much nearer.

Having accomplished all that I had purposed in visiting Lake Saima at this time, I returned to Willmanstrand,

making the voyage in some twenty hours in the small yacht-like steamer I have spoken of, steadily making its 9½ knots, or 10 miles an hour, and arrived there in comfort. Not so my fellow-voyager. He remained a day longer in Kuopia, and set out on his return in the steamer in which we had together gone there. Of his mishap he wrote to me :—

'I was sleeping in the longitudinal berth corresponding to yours in the "Aurio," when I was suddenly awakened with a crash which made my teeth jerk, and my travelling desk, which was on a shelf above my head, popped down on the top of my head. I got up, and screwed down the window, which was open, as the vessel was heeling over, and I was afraid she would go on her beam ends; and I then proceeded to dress, taking the precaution to throw the cabin door open, and putting my packages on the bed. The vessel was pretty full, and many rushed up without their clothes. After getting my clothes on, I got my luggage on deck, when I found that five feet of the vessel was high and dry on a mountain. The "Aurio" came past soon on her return voyage. She came and tried to tug us off, but it was all in vain. I then went back to Myslot in the "Aurio," and came on again in the evening with the "Elias Loimsot." We found the "Ainamo" still on the rocks when we passed, but two tugs were pulling away, and shortly thereafter she got off, and arrived in Willmanstrand on Sunday morning, about a quarter of an hour after the "Elias Loimsot." As I did not care much about getting here on Sunday night, I went through the canal with the "Ainamo," stopped on board all night, and got here on Monday morning.

'As to the cause of the shipwreck, it appears that the captain being tired had asked the pilot to keep careful watch, while he rested for a little. The pilot promised to do so, and the captain went down. After this the pilot seemed to have thought, What is the good of having the responsibilities of command without its indulgences! and he would have a chair up to sit on at the wheel. He next

determined to have a little sleep, carefully keeping his weather eye open. The weather eye had refused, however, not to share in the general indulgence; and he had only slept for about ten minutes or a quarter of an hour before the vessel reached the shore. The poor man would pay dear for it, as I was informed that a pilot he would be no more.'

Intricate as are the channels to be followed in winding through the archipelago and island-crowded waters, such mishaps are of rare occurrence. The training of the captains of the smallest steamers is thorough and efficient. There are several Schools of Navigation in the Grand-Duchy. They must have passed satisfactorily through the whole course of study followed there, and prescribed examinations in every branch, and they must have served at least six months on board a British vessel. One captain with whom I sailed had been twice from Liverpool to Baltimore, and once to New York; another had been from London to India, and from London to China. They, and others with whom I have sailed, spoke English fluently, and in every respect had the bearing and manners of educated gentlemen.

The facilities for inland navigation are numerous, and in every way satisfactory. Many of the thousand lakes are connected by canals, and of these most are licensed for the passage of steamers.

There are canals licensed for steam communication between the following towns: (1) On the lakes of the Savolakscarelie Canal, between Joensuu, Nyslot, Willmanstrand, St. Michel, Kuopia, and Idensalmi. During the summer not only are there tug-boats for the conveyance of passengers and goods, but there are seventeen steam-boats and steam-launches, of which five come by the Saiman Canal to Wyborg, and then on to St. Petersburg. There are two departures weekly to and from Wyborg and Kuopia, and Wyborg and Joensuu. (2) On

the Paijaanne, between the station of Lahtes and Jyväskyla, there are six departures weekly. (3 and 4) A daily communication has been established between Tavastehuis and Tammerfors, and three times a-week between this last town and Wisuvesi and Filppula.

There are also lines of steamers on the Pielisjarvi, between Nurmis, Lieksa, and Enaitaipale; on the Oulujärvi, between Kajana and Waala, &c. On the Ladoga a regular line plys between Sordavala, Walamo, Kexholm, Kanevitz, Schlusselburg, and St. Petersburg.

The Saima Canal is the aquatic highway from the Baltic to Lake Saima, and countless lakes or lakelets beyond. The outlet of the waters is by another, a more precipitous and a more circuitous course, the river Wuoksi, which, after passing through several lakes and gorges in the mountains, and flowing onwards in successive rapids, alternating with the placid stillness of outstretched lakes, finds its way to Lake Ladoga, the largest lake in Europe, having an area of 6190 square miles—nearly equal to that of the whole principality of Wales.

Into this lake flow also the waters of Lake Onega, and the waters of Lake Ilmen, while the northern extremity of Lake Onega almost connects it with Lake Sigh and the White Sea; and by the Neva, which flows through St. Petersburg, the waters of these lakes empty themselves into the Gulf of Finland, and thus into the Baltic, and thus into the German Ocean.

The Wuoksi on its course has to traverse the mountain side of Salpansfelka in a furrow 140 feet wide, Through this narrow channel, about 3000 feet in length, sixty-seven millions cubic feet of water force their way every hour. Within the same space of time the Niagara Falls pour about forty-two millions cubic feet of water into the basin below, which is not two-thirds of the quantity of water rushing through the rapids here, widely celebrated as the Falls of Imatra.

These may be reached now most conveniently by steamer from Wyborg to Rattigarvi, one of the stations or locks on the Saima Canal, and thence by land conveyance. I have been informed that there is now a tramway between Rattigarvi and the Falls. I visited them along with a party of friends in 1860, before the canal was open for passenger traffic. We proceeded from St. Petersburg by steamer to Wyborg, and in the cool of the evening we started in a caleche for Imatra. We reached the Falls about three o'clock in the morning. It was the last day of July, and being near the summer solstice, it was light all night. We had travelled through a lovely country; there was hill and dale, woods and water; and we had good horses and excellent roads.

After a hurried look at the Falls, I went to bed, and by six o'clock I was again at the water side. The forenoon was given to botany, to entomology, and to rest, some of us gathering flowers, while one, with the occasional aid of others, was catching butterflies, and another was taking pencil sketches of the scenery around. In the afternoon we visited a waterfall about four miles lower down, where the river empties itself into a lake. After tea, we drove to a ferry some three miles above Imatra, where we crossed the stream, caleche and horses and all, and we drove along the other side of the river to see the Falls from that side, whence only a sight of the whole at once can be obtained.

The river is like the Niagara, a stream carrying the water from an upper to a lower lake, and these are parts of a chain of lakes, the level of each of which is lower than that of the one immediately above it. Here the upper lake is a prolongation of the Saima, which, with its ramifications and connected lakelets, may be said to divide with the land, and share between them, the whole extent of Finland.

Like the Falls of Niagara, the Falls of Imatra present an appearance differing greatly from the conception generally formed of a waterfall; but this it does in a different way. In the Falls of Niagara the immense stretch of the fall in

breadth, and the great excess of this above the height of it, occasions to many a feeling of disappointment on its first being seen, which continues until the spectator is enabled to realise what the height of the fall actually is, and then what the immensity of the flow must be, seeing that it is a fall of such a breadth and of such a height. In the Falls of Imatra, we have what the spectator is at first disposed to call a rapid rather then a waterfall; but *such* a rapid! The Falls remind me of the Falls of Clyde; but while there is a similarity, *what a difference!* Here you have Corralinn, and Stonebyres Linn, with its upper and lower fall, and much more, all combined into one continuous plunging, dashing, foaming, pouring torrent, rushing through a rocky defile, apparently exceeding half-a-mile in length. There is on the eastern side a table-rock, whence the whole can be seen in one *coup d'oeil*—or rather, I should say, whence the whole can be traced with a continuous sweep of the eye—for this cannot take in the whole at one glance. But view it whence you may, there it is: the torrent like a charge of cavalry, the cavalry rushing onward—broken—trying to re-form, all the while pushing on—failing to form—rushing and plunging, dashing, foaming, roaring on, on, still on. I have seen it in sunshine and rain, at sunrise and at sunset, by moonlight and in darkness—such darkness as there was when dawn and dusk constitute a single twilight—in clear light and with an overcast sky, and I was filled with a growing and continually expanding idea what I saw of the Falls.

The vegetation of the whole locality was luxuriant. Amongst its productions were many of my countrymen—plants with which I at once claimed acquaintance, as often do townsmen and even fellow-countrymen when they meet in a strange land, though, perhaps, had they met at their home they might have passed without even a look of recognition—and with these were many which told of a foreign land; and this gave a peculiar relish to the enjoyment experienced in recognising the former, by the

assurance they gave that we had met in what was really a land of strangers. Amongst the most luxuriant were wild Canterbury bells, and other species of campanula, agrimony, golden rod, shepherd's rod, willow herbs great and small, tormentil, silverweed, milfoil, cranberries, blaeberries, *goloobnitza*, *broosnika*, and *sweinelange*, in abundance. Ferns were not awanting, and mosses there were in plenty, and lichens—but *such* lichens!—in number, variety, magnitude, colouring, beauty of form, and height of growth, far surpassing everything in that class of plants I could previously have imagined. There were rocks—and *rocks of such magnitude!*—enamelled with them as is a field in Britain with buttercups and daisies. I brought away a *Canina peltidea*, 12 inches in diameter. With the flowers named, there were very fine knapweeds, St John's worts, chrysanthemums in considerable variety, and exquisitely formed blue cornflowers, and cow-wheat; but the campanulas and lichens were what arrested the eye—the campanulas on this side, the lichens on yonder.

The village in the vicinity of the Falls is a wretched ruckle of old houses, inhabited apparently by the poorest of the poor; but I have seen more than one peasant—apparently, however, peasants from a distance, and Russian—not Finnish—enjoying the scenery as much as did I; one peasant I still see, now launching trees into the torrent, witnessing their sudden disappearance, watching for their reappearance, tracing their progress with the rapidity of an arrow which told of the velocity with which they were carried down the stream, and of the desire of the observer to catch yet another sight of the sea-serpent-like body rushing on—now standing in silent amaze: I sympathised with his feelings, both in the one case and in the other.

Not the least exciting of the adventures of the day was the crossing of the ferry, in a smooth reach between two rapids, in a large boat with trees for oars—trees cut at one end into oar-like blades, and at the other cut so as to allow of their being held and plied. There was the rapid

above threatening to come down and engulf us; and there was the rapid below, from which, had it caught us, there was no escape, and the Falls apparently but a little way, though really some two miles, below the ferry.

Next morning I was up by six o'clock as before, and down to the Falls; at eleven we started for Willmanstrand, distant some forty versts, on our return to the coast by another route. The scenery was lovely; it was like that of the Trossachs and that of the Cumberland Lakes combined, with hills wooded to the water-edge. Such land may be unproductive to the inhabitants, but to the tourist it is most delightful to see.

After dinner we started on our return journey to Wyborg, travelling along beautiful roads, through scenery similar to what I have described, crossed the Saima Canal by the way, and arrived at the port at eleven o'clock; but at the inn we could only get beds for the ladies. One of our number slept on a sofa there as guard of honour, I and another went on board the steamer which had arrived; but every berth was occupied. One slept on a sofa, the other on the dining table. By six o'clock we were strolling about, and by eight we were again under weigh, and by evening we were again in the capital.

Now, as has been intimated, the facilities for visiting the Falls have been greatly increased. By train, by steamer, and apparently by tramway cars, passengers may proceed from any part of the coast to the spot; and there a spacious and elegant hotel affords every comfort to those who desire them, while small steamers convey passengers on the canal to or from Wyborg and Willmanstrand. Communication between the banks of the rapids is effected by means of a wire rope, 170 feet long, and $3\frac{3}{8}$ of an inch in diameter, along which is drawn a basket with room for two passengers.

On the spot where the water has attained its greatest velocity has been erected a pavilion affording shelter to those who desire to enjoy the sight in comparative com-

fort. High above the bed of the present rapids immense caverns have been hollowed in the adjoining rock, indicative of the tunnelling of the river in byegone times. At a distance of about fifteen miles below Lake Saima the Wuoksi is navigable. Before falling into Lake Ladoga at Kexholm it spreads out into two large lakes, but throughout the greater part of its length, according to Murray, it winds between high banks formed of granite, with layers of clay and sand. The total length of the river is 170 versts, 113 miles. Geological data prove that the river is decreasing in volume, the ancient breadth of its course being in many places marked by round, kettle-shaped holes, in which boulders no longer gyrate. The limits of the old bed may be clearly seen in the vicinity of the Falls.

The Falls of Wallin-Koski and Küri-Koski, a short distance beyond those of Imatra, are inferior in grandeur, but far more picturesque. The Falls of Imatra may be taken as a type of many of the waterfalls met with in Finland, in Sweden, in Norway, and in the same latitudes in Russia.

It is easy to imagine the phenomena accompanying the gradual advance of a waterfall upwards in the water course of a river. In many books on geology the process is described. To meet a popular opinion that rivers flowing through ravines found these ravines existing as rents in the mountain chain, and availed themselves of them to escape to a lower level, Professor Geikie has given in a volume entitled "The Scenery of Scotland, viewed in connection with its Physical Geology"—a volume I may afterwards have occasion to cite at greater length—a graphic account (p. 18–34) of the action of a river in forming for itself a bed and a valley in which this bed seems to lie at rest. More briefly, the action of a waterfall may be described thus: Where the current below the fall is not so strong as to roll away the fallen rocks, where it is such as to sap the

foundations of the rocky barriers on either side, and where the freezing of water percolating into crevices of the rocks loosens and separates large blocks from the continuous bed or strata, the precipitation of these into the bed of the torrent—the accumulation of all these rocks must tend to produce such a torrent as the one we here see.

On my return from Kuopia, as on the occasion of my return journey from Imatra twelve years before, I passed through Willmanstrand. On returning from Kuopia I made my way through woodlands to the railway station of Simola, some twenty versts, or fourteen miles distant. In the course of this little journey I saw abundance of mosses and lichens, like to those of which I have spoken, as seen by me at the Falls of Imatra.

The trees I have seen in Finland are not destitute of lichens, but trees covered with them are comparatively rare, while on the rocks they abound. Large boulders, boulders the size of a cottage, may be seen marled or variagated by a covering of lichens, which, like the lakes and islands, may to be reckoned by thousands. I have seen on rocks unbroken patches of moss twelve square feet in extent. I have seen patches of what seemed an hundred square inches in extent, rising in the centre three or four inches high. And again and again I have seen stones which might be presented in a class room as specimens of the alleged succession of natural crops on bare rock—lichens, mosses, and ferns, growing there simultaneously. In one case, and, according to my impression in many more, I saw lichens, mosses, ferns, and plants of *Gnaphalium*, and of the cranberry and of the whortleberry; and on many I have seen the roots of trees which had been burned in a forest fire. Much of the soil may have been blown thither, and rested in hollows, or have found a resting place in cracks and rents; but the appearances presented were not the less interesting. I examined a few; in most of these the extremities of the roots of the flowering plants terminated in decayed or decaying patch of moss.

I proceeded by railway to St. Petersburg, passing through Wyborg without stopping. In an old edition of Murray's Handbook, written before this railway was constructed, I find it stated, and the statement is equally applicable now as descriptive of the journey from Lovisa, a town some forty miles from Borga, to Frederickshamm, on the road to Wyborg and St. Petersburg:

'Lovisa was once a frontier post of the Swedes. One of its streets descends to the very sea-shore, while the others are arranged in a kind of amphitheatre on the side of a hill. Some remains of its former defences are yet to be seen. Two or three massive walls, with their embrasures even now almost perfect, seem at a distance to command the town. The country beyond this is wild enough: no traces of cultivation can be discerned, and as far as the eye can reach it is one barren heath, with here and there a few boulder-stones and fir trees thinly scattered among the heather. The road, however, is excellent, hard and smooth, and full of picturesque windings, and the traveller will be fairly hurled along at a rapid pace, and referring to the gallop at which all journeys are made in Finland,' the writer goes on to say:—'The traveller will thus speed on his way through Finland, and frequently without meeting a human being from one station to the next; the dark pines and massive boulder-stones (many of a magnitude which will astonish the traveller or any geologist who has not traversed the country), the red verst posts, and a rugged scanty flock are the only objects that meet the eye. In some places partial clearings, principally made by fire, add one new feature to the landscape; and the charred and blackened trunks of the larger trees, which have resisted the power of the flames, standing like giant sentinels in the blank space around them, contrast strongly with the dark green of the living pines, and the bright lichens of the boulder-stones scattered around them. Many of these huge stones arise from the earth in single masses, and it was from one of these that the

Alexander Pillar in St. Petersburg was wrought.* Other boulders may be seen heaped one on the other in strange confusion and fantastic shapes. The drive between Lovisa and the next station is very beautiful, and hill and dale are passed with scarcely time to look down on the torrent that foams and boils below in its narrow and rocky bed, as the traveller dashes over the narrow arch that spans each yawning chasm.' A drive of something more than ten miles brings the traveller to Aborrfors. 'The position of this village is one of the most picturesque on the road. Approaching it from Lovisa, there is passed a broad stream winding along a valley, immediately beyond which rises a hill of considerable elevation; its sides and summit are covered with red cottages, and around them is a forest, with its giant boulders looking like specks on the dark-green mantle.'

Broby is next reached, some fourteen miles distant. 'Between this and the next station, a fortress which formerly marked the frontier of Sweden, and was then guarded with the most jealous care, is passed. Its scarped sides and edges still remain; but the place is, in other respects, totally neglected, and even uninhabited. Shortly after, a turn in the road brings the traveller in sight of a beautiful waterfall of the river Kymen, near Högfors;

* This monolith of red granite, exclusive of pedestal and capital, is 84 feet in height, and 14 feet in diameter. It originally measured 102 feet, but was shortened from a fear that it was not of sufficient girth to sustain such a length of column. The base is also a monolith of the same red granite, 25 feet in height, and nearly the same length and breadth. The capital measures 6 feet; it is surmounted by an angel and cross, the former 14 feet, the latter 7 feet, in all the mount is 154 feet 9 inches in height. The shaft of the column alone is computed to weigh 400 tons. It was raised in its rough state, and polished after it was fixed on the pedestal. It was rolled up a spiral corkscrew-like scaffolding whereby the upper extremities was raised, while the lower was comparatively stationary, and it was thus brought to the perpendicular without a shock. All was done under the direction of M. Montferrand, the architect of the Isaac Church. I witnessed the completion of the work, but not its commencement. St. Isaac's Plain, now laid out as a garden, was filled with soldiery, as were the windows and roofs of the surrounding buildings. It was computed that 200,000 people were present, 105,000 soldiers and 95,000 spectators. The former knelt, or bowed the uncovered head if on horseback, while the metropolitan of St. Petersburg offered the consecration prayer. The chaunt of his voice was heard on the house top where I was, like the swell of long low waves, passing over the heads of the multitude, and when these rose from their knees, or raised their bowed heads, it was like the resurrection of the dead as pictured by fancy. It has been mentioned in the beginning of the chapter that the summit of it may be seen in passing up the Neva.

as such it would be considered by many; but to travellers who are fresh from Trollhättan or from those of Italy, its beauties will appear somewhat questionable. This stage is hilly; the road, however, is good.

'The next stage is long, and almost the whole way through one unbroken pine forest, the trees coming in many places quite down to the edge of the road; the whole country being covered with stupendous boulder-stones, many of them far larger than the one which forms the base of the celebrated statue of Peter the Great at St. Petersburg. In some cases the rock pierces through its thin covering of earth and vegetable matter, and spreads its hard surface, uncovered by shrub or plant, over a space of many square yards. At length the view opens, and the Fortress of Frederickshamm is seen on the opposite side of an arm of the sea, which runs some miles inland, and round the shores of which the road winds its way.

'Not far from Frederickshamm is Risalaks, near which are the granite quarries from which were drawn the monolith columns for the Church of St. Isaac at St. Petersburg.' *

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* These references, made first to the monolith on which stands the statue of Peter the Great in St. Petersburg, and next to the monolith granite columns in St. Isaac's Church, may render a few words of information not unacceptable to the untravelled reader.

In what may be considered the centre of the city is what was formerly known as St. Isaac's Plain, now laid out as a public garden, skirted by the Neva, and almost entirely surrounded with public buildings—the Senate House, the Synod, the Admiralty, the Winter Palace, the *Glavnoi Stab*, and St. Isaac's Church, &c. On the erection of this church, of which it may be said it "was forty years in building," much treasure was expended: inside, pillars of lapes luzuli and of malachite give adornment to the altar, and outside are tiers of pillars of red granite, each of them consisting of a single stone. Opposite to this church, but at a considerable distance from it, stands the colossal bronze equestrian statue of Peter the Great, erected to his memory by Catherine the Great. This stands upon a very large boulder, slightly hewn into shape, which was found in the fields, and transported thither for the purpose, and is an object not less remarkable than the statue itself. At the opposite end of the plain, but not in the same line, stands the monolith pillar erected and dedicated to the memory of his brother Alexander I. by his brother, the Emperor Nicholas—statue and angel and church all looking toward Finland, the land whence these polished monoliths were brought. To the St. Isaac's Church there are four porches, supported by eight monoliths of polished granite in front, and three on the side, each of them 56 feet in height, and 6 feet in diameter, with bases and capitals of bronze; and the five domes are supported by similar monoliths of polished granite of smaller size.

The boulder employed as a base for the equestrian statue of Peter measured when found 42 feet long, 27 feet broad, and 21 feet in height. At one end was a crack, by prolonging which a natural slope, admirably adapting the stone for the purpose for which it was required, was supplied. It was rolled from Finland on cannon balls.

CHAPTER II.

BOATING ADVENTURES ON THE ULEA AND THE TORNEO.

In the preceding chapter I have described what are a few of the characteristic features of Finland, its woods, and waterfalls, and lakes. Two-fifths of the country is covered by lakes, a hundred of which may often be met with in the course of a day's journey, some great, some small, some wild or romantic in their aspect, some beautiful and picturesque. They constitute four or five distinct series or water systems, the lakes and lakelets of which flow one into another, and thus pour their waters through successive basins into the sea. And if resembling one another in their peaceful features, they resemble also one another to some extent in their wilder aspects. There are not two Falls of Imatra in Finland, as there are not two Falls of Niagara in America, two Falls of Trollhattan in Sweden, two Falls like unto the Victoria Falls of the Zambesi in South Africa; but there are numerous rapids and falls of lesser magnitude in Finland. Mention has been made of those of Wallin-Koski and Küri-Koski, not far from Imatra; and often elsewhere does the traveller hear of other *Koski* or falls.

In some places these can be utilised as a supply of water-power applicable to industrial operations as is done in Tammerfors, in which name we have the synonymous Scandinavian term *fors*, instead of the Turanian term *Koski*. There is here a magnificent waterfall. Dr Patterson, one of the founders of the Russian Bible Society, travelling in Finland in 1812 on business connected with the printing of the Scriptures, passing this way, was struck with the facilities for driving machinery by water-power

which were presented by the place. Many years after this he mentioned to Mr Finlayson, a Scotsman resident in St. Petersburg, the opinion he had then formed and still held. Mr Finlayson gave further consideration to the matter, visited the place, formed his plans, applied for and received pecuniary assistance from the Government, and erected mills for spinning cotton, with other appliances. Now it is called by the Finns, with some measure of pride, the "Finnish Manchester." Many years ago the census showed that it had at the time some 2000 inhabitants, of whom 160 were employed in a paper manufactory, and 700 in a woollen manufactory. Judging from the appearance presented by the town, the numbers must have been very greatly increased since then.

In other cases the fall, though more like the rapids of Imatra than a precipitous cascade, is so much less impetuous that it does not prevent navigation from the upper reaches to the sea. Thus is it with the upper rapids of the Ulea, by which the waters of the lake of that name find their way into the Gulf of Bothnia at Uleaborg, where, at the mouth of the river, King John III. of Sweden, in 1570, built a castle so named as the Castle on the Ulea river. This castle was destroyed by lightning in 1793; but meanwhile there had sprung up around it a village which, becoming an important centre of trade, municipal privileges were granted to it in 1605. Ship-building is here carried on to some extent, and there is a considerable trade, principally with England, in tar and deals. The Tjar-Hoff, or tar depôt, sometimes contains upwards of 100,000 barrels of tar. Rapids are numerous on the river; there are five rapids—the Meri-Koski—opposite to the town. The boats by which barrels of tar are brought down from the interior by the river Ulea are described as made of the thinnest boards, which bend like paper. When shooting the rapids, they require to be, and they are, most skilfully managed. My friend and fellow-voyager on Lake Saima, the Rev. Mr Nicolson, had on another occasion some experience of this.

He had occasion, in the prosecution of his special work, as agent of the British and Foreign Bible Society in the North of Russia, to cross the Grand Duchy of Finland, to the north of Lake Saima. He proceeded by the Neva from St. Petersburg to Lake Ladoga. He visited Konivets, Hexholm, at the mouth of the Wuoksi by which Lake Saima discharges its surplus waters into the Ladoga, and Walamo. Subsequently disembarking at Sordavala, he had to travel by land conveyance to Puhois, a distance of some eighty versts, about fifty-three miles. There embarking on a lake steamer, of which he found many bobbing up and down everywhere on the Finnish lakes, he returned southward to Nyslot, or Newcastle, as the name may be rendered in English. Thence he found his way by steamboat to Kuopia and Idensalmi, and thence with very little land-travelling to the lake Ulea Träsk, upon which steamboats again were found plying. Above this a good deal of tar is manufactured. Everywhere had dark pine woods been seen, sometimes scraggy. The country was undulating, not unlike the district of Buchan, in Aberdeenshire, but rocky, seedlings and saplings appeared to be spreading out towards the lakes wherever they could obtain a foothold. In collecting the tar or turpentine on this side of the watershed, the bark is ringed half round the tree; an incision is made in the trunk, and the material is collected as it oozes thence; and the tar-boats supply a means of transit down the rapids of the Ulea-elf, where steamboat conveyance fails.

The tar-boat is very long, and built of two broad planks joined boat-shape. Two rows of tar barrels are laid along the greater part of the boat, and two more barrels are placed across the boat at each end. A second narrow deal is nailed along the gunwale on each side to turn off the bulk of any wave. A long oar projects astern. The whole structure is elastic, I had almost said as mobile as an eel. Government licensed pilots steer the boat, and the only place for a passenger is a seat on one of the barrels of tar. The rapids recur for many a mile; but the

boat shoots them beautifully, now rushing apparently against a projecting rock, but passing it safely; now rushing upon broken water, but only to rise on it like a sea-gull on a wave, and pass on safely beyond.

At length Uleaborg on the coast was reached, and by a coasting steamer touching at all the more important ports on the Finnish coast of the Gulf of Bothnia, the traveller reached Abo and Helsingfors in safety. He did not state in a letter that he wrote to me giving an account of his tour, but I afterwards learned in conversation with him, that at one place the fragile bark and its whole cargo was submerged and broken up; but all floated, the cargo was soon collected again, and the boat, if boat it could be called, reconstructed, and they resumed their voyage after a brief delay.

I know something from experience of the nervous excitement produced by the descent of the rapids of the St. Lawrence, and from conversation with those who have had like experience in connection with the descent of the rapids of the Zambesi, of which adventure Dr Livingstone has left us a graphic account, I gather that their feelings must have been similar; and like feelings appear to be generally produced in like circumstances. The incident has been mentioned, less with a view to awaken a sympathetic feeling by leading the reader to fancy what his feelings would have been, than with a view to making the personal narrative subservient to the production of a vivid realisation of the physical aspects of the country. With a like view I proceed to cite an account given by the author of *Frost and Fire*, of a descent made by himself and a brother tourist of the Torneo, the river constituting the boundary on the extreme north of Finland, between the Russian territory and Sweden.

Describing the Torneo boats, the writer says: 'The bow rises about three feet from the water, and is very sharp; the boat gets rapidly broader and lower for about five feet to the place where the first rower sits upon the bottom boards and works two broad paddles. These work in

crutches made of knees, and are fastened with loops of twisted birch root. The boat then tapers rapidly aft, and ends in a sharp stern rising like the bow, but not so much. Close aft sits a second rower who works another pair of sculls; and right aft, in the very stern, the steersman stands up and works a broad spade-handled paddle in a loop of birch roots. The length of the boat may be about thirty feet, the greatest width about five.

'The river was about as broad as the Thames at Richmond, with a good stream of clear water, which promised well for rapids, on the journey of 300 miles which lay between us and the sea.

'The river banks are low and sandy, covered with stunted forest, except where the land has been cleared for farming. The crops, chiefly barley, were being carried home. The sheaves were hung upon tall racks made of fir trees, and the ears were turned to the sun.

'The night was frosty and beautifully clear.

'Saturday, 8th September 1849.—Our intention being to get to Muonioniska, we rose early and started at six. The morning was magnificent, but very cold; stubble, sand, corn, trees, everything, was glittering in the sunshine, as if powdered with diamonds; and the pools were covered with ice a quarter of an inch thick.

'Our boat was manned by three large sturdy men, dressed in blue woollen, with mittens to keep their hands warm; and we seated ourselves upon our traps in the middle of the boat, wrapped in plaids and great-coats, with guns for pot-shooting.

'We could not talk to our men, so we gave them some 'baccy, and grinned and talked to each other.

'The river for some ten miles or so was unchanged. There were low banks, low islands, firs, and birches, and here and there a slight stream unworthy of the name of rapid.

'Our men pulled well and fast, changing now and then, till we reached a station where we landed. We were to change boat and crew, but knew nothing about our fate

for want of a tongue. I had managed to learn to ask for milk, and to count; so we got a drink, paid our men, and at 10.30 started, shouting *Huaste!* (good-bye.) Our new steersman was a very fine man, six feet high at least—a straight limbed fellow as one could wish to see; he was quiet and grave, and reminded me strongly of an old Scot.

'Half the village, well-dressed, comfortable folk, came down to see us go, and shouted *Huaste!* in chorus.

'No one had warned us of what we were now coming to. The broad placid stream which we had been following changed all at once, and in a few minutes we were in a Torneo rapid.

'The banks changed their character also, and for some miles there was a constant succession of rocks, and pools, and whirling eddies, that seemed made for fishing.

'Our men seemed to know what they were about so well that there was no reason to fear shipwreck; but to pass some of the places which we now whisked through without good boatmen would be certain destruction.

'Our first leap was down a regular waterfall, about four feet high; and then, shooting down at railway speed, the men pulling like racers, we had to thread our way amongst large stones, breakers, and whirling pools that looked impassable. Our quiet steersman was a study. His face lighted up with the excitement, his eyes glared and sparkled, his long hair floated backward, his mouth opened slightly, and then his lips were compressed, and the teeth set when he had taken his line and meant to keep it. He plied his paddle with strength and skill, and every attitude showed off his well-knit frame. The others worked hard and silently, watching the steerer's eye, and ready to help him at the slightest sign. It was evidently no child's play, and they were not children. I sketched the steersman at one place, and we agreed that we were safe in his hands; so we smoked our pipes and held our tongues to give the men fair play. That rapid alone was worth the journey. That night we were obliged to stop short of our point, for night fell, and we could not shoot the rapids in the dark.

'The character of the river-banks to-day was not picturesque. The country was low, and covered with forests of birch and fir that seemed endless. There were rocks occasionally, and grey moss seemed the covering of the ground. The river bed between the rapids was generally sandy, with large boulders here and there. In the rapids the ground is a pile of enormous stones all rounded; they are ten or twelve feet in diameter, and at times much more. They are about the size of hay-ricks and hay-cocks in a hay-field; and they are like those which are scattered about on the fjeld. These rise high, or barely reach the surface, betraying their position in the stream by a curl in the water; or they may be out of sight, and barely raise a wave.

'The steersman has to avoid them all, while the boat is going "hard all" down a rapid stream, so as to keep steerage way.

'I calculated that we had gone fifty miles in the twelve hours.

'Sept. 9.—Rose at six, and found a white world; snow a foot deep, and more falling; wind blowing hard, and a very uninviting temperature. . . .

'After breakfast our host smoked his pipe, and read his Finsk Bible; and his wife having put the house in order, and having washed the dishes, sat down beside her husband. There was an air of Sunday quiet about them all that put me strongly in mind of the Highlands; and their marked features, brown faces, and bony hands, their coarse woollen garments, and long hair, called up visions of Covenanters, as painters love to depict them.

'At 11 it got finer, so we started, wrapped in all the clothes we could muster.

'It was soon evident why our men would not go on in the dark. Rapids were bad and numerous. The first came at 11.38, and was succeeded by a magnificent pool. The second came at 12, with a still finer pool below it; a third was reached at 12.15, which we got down in ten minutes. I should think it was two English miles long,

and it was very dangerous, though not so beautiful, as yesterday's rapids. Looking back from below, the river seemed a mass of broken white water amongst a steep pile of rounded stones.

'Then came a long stretch of broad, still water, to a place called (I think) Oolicola Muonio; and then we came to Muonionsika itself.

'This town is half in Russia, half in Sweden; it contains a church, a merchant's house, and a lot of excellent wooden houses, It is less a town than a cluster of detached farm-houses, each with farm-steading, corn-rack, and offices. The best sort are painted red, the rest are grey from the weathering of the bare wood.

'Here we were hospitably entertained by the merchant's wife, and slept on beds of down.

'Sept. 10.—Rose early from the first beds we had slept in for ten days; had a famous breakfast, and departed.

'Our new crew of three had to break their way through ice in a creek below the house. They were engaged to take us all the way to Torneo; and one spoke a little English, which was truly English in kind. With them came a hard-featured, sharp-looking fellow, who was to steer us down the famous Aiomboika Foss. He is supposed to be the only man that can do it, and receives a tax of about two shillings (English) for conducting boats that require his services. It is possible to walk, but we wanted to see the fun. The morning had been very fine, but by 1.30 P.M., when we started, the hills had vanished in mist, and there was a drizzling rain, which promised to get worse, and kept its word. As soon as we were seated, the men shoved off, and after a little splashing in ice, we got to the open river. The new boat was like the last, but rough fir boards were fastened to the sides to resist the heavy water.

'The famous steersman, looking placid, chewed a quid, and took his place and the paddle, without taking off his mittens. Behind him, peering over his shoulders, was the youngest of our crew. The old bird was teaching the

young idea how to shoot the rapids. At first our progress was much the same as before, the men pulled hard, and the boat went fast; our steerer chewed his quid, and guided the boat with the skill of a London cabman in a crowd. I should have thought twice about steering even there, but it was evident that we were only at the beginning. The banks grew wilder, and rocks here and there replaced the rounded boulders which had hitherto been the principal feature of the river-bed. Presently our friend began to roll his eyes, and grip the spade-handle of his steering-paddle, and the roar of the water a-head told of something coming

'I raised my head to look, and was ordered to lie down and not hide the view; so down I went, but I could still see that we were rushing, end on, at a ridge of black stones that reached half over the river, and that the whole of the stream was dancing and tossing, like a mill-race, past the end of the bank. There was broken water, like a heavy surf, right up to a steep broken rock on the Swedish side. We seemed to be rushing to certain destruction; but just as we seemed to be rushing into the race, a turn of the wrist cleared the outermost boulder by a few inches, and we shot round a corner into a splendid pool. It was done with the most perfect neatness and composure, but a few inches the one way or the other would have given us a hard swim.

'The steerer now seemed to explain to his pupil all about this point, and how to pass it; and then he condescended to take off his mittens.

'The next shoot we had to go further into the stream. We were drenched, the boat was half-filled with water, and then, as there was worse to come, we rowed to the Russian bank, and baled, and shook our feathers.

'We had not much time to look about us. The river had gathered force and speed for the last six miles, and here it made a final leap. The river-bed made a bend below us, and the whole body of water dashed with a roar like thunder, against a perpendicular rock, some 20 or 30

feet high. There were bad stones on the shallow side; it seemed quite impracticable; our pilot only grasped his paddle the tighter, and set his teeth, and off we went. It was grand, but somewhat terrible, to feel the frail boat whirl round as we entered the stream; but it was worse when we got fairly into it, and dashed at the wall of rock. We were covered with spray in an instant. No one spoke, and no one could have heard for the noise. On we rushed over the waves, nearer and nearer, faster and faster, towards the bank—the high bow slapping hard into the waves; but skill and coolness were at the helm. An eddy seemed to throw us bodily off from the rock into the tail of the stream, and the steersman knew all about it. The old boat writhed and cracked from stem to stern, and pitched headlong into the waves, till I thought she must part or founder. The man in the bow was nearly upset by a wave which jumped on his back, and he nearly cut a crab; but the pilot was working his paddle with might and main, and we shot into a great boiling, black pool, safe, but well ducked. I know nothing grander than such a torrent, unless it be the rolling Atlantic; and nothing gives one such an idea of irresistible force as Atlantic waves after a storm.

'The rest of the rapid was bad enough; but all hands seemed to think it child's play. I would have stared at the notion of shooting down such a place a month ago; now we thought nothing of it.

'We reached the last shoot at 2.45. We had made about seven miles in less than an hour, including stoppages to bale.

'I paid the river guardian, shook his hand heartily, and with a volley of *Huastes* we parted.

'It was cold, wet, and miserable; but our men pulled well, and we chatted merrily as we glided down a smooth stream.'

The narrative goes on to tell of a voyage of successive days—of the river being 'wide and smooth, the banks

low and covered with forest, unless cleared for a farm'—of river-banks 'low and covered with birch, fir, and young moss'—of entering the true Torneo, coming from the west, a larger river than was the branch they had descended.

'Sept. 14. At twelve we reached Gatiloski rapid. It is magnificent. The throat of the pool is very rocky, narrow, and deep. I could have thrown a stone over it. In the middle the river gets wider, and the boat shoots into glorious boiling pools, with still casts made for salmon. Near the tail the river divides. The smaller branch takes a leap of 10 or 12 feet; the main stream thunders down with a terrific roar, and in the middle rises in waves 10 feet high at least. Our boat slipped down the side, scraping salmon-stages, from which the Finns spear great numbers of running fish. We got down safe and sound, but well drenched as usual.

'At 1.50 we landed the pilot of the rapid, and I tried a cast for a salmon, but all in vain. From the rapid the river is smooth and broad for a long way.

'Sept. 15. The river is like a great lake, three miles wide At 10.30 we reached Matagoski, the last and largest rapid. The whole river, which had a good stream where three miles wide, pours, with the speed of a mill-race, through a gap in a rock step 300 yards wide. The throat of the pool is like the escape of the Ness from Loch Ness, but everything about it is magnificent, except the hills. It was frightful to look back at some of the places we passed. The rapid is about five miles long. About as much water as flows past Bonn runs like a mill-race most of the way, amongst boulders of the usual pattern.

'The steersman was very old, and sent us slap over one big stone, but we slid quietly into the river on the other side, and were none the worse. That night we got to Haparanda, close to the Gulf of Bothnia, and found ourselves at the end of a road which leads to Stockholm.' Thither he and his fellow-traveller proceeded by land.

Such narratives and statements, whatever may be apparent of their immediate connection with the subject of Forests and Forestry, have a connection, little obvious it may be, but nevertheless real, with that subject, inasmuch as they bring under consideration an important feature of the physical geography of Finland—a country in which the lakes have a larger area in relation to that of the dry land, and the islands a larger area in relation to that of the mainland than is seen in most of the countries of Europe.

CHAPTER III.

THE WATER SYSTEMS OF FINLAND.

THUS far, while allusions have been made to dry land, much more has been said about water—canals, lakes, rivers, waterfalls, and rapids—and so it must needs be in an introduction to the study of the Forests and Forest Lands of Finland, according to the impression produced upon me by what I have seen there.

In a treatise on the Grand Duchy by Dr Ignatius, that distinguished statistician, remarks: "Finland is not a country of mountains." No! It is rather a country of valleys; and the evidence of this is, that it is a country of lakes; and as all mountain systems have, as their compliment, a system of valleys, we find the *thalweg* of the valleys of Finland have given rise to several distinct water systems, composed of a series of lakes, connected by rivers or streams. Of three basins spoken of by Dr Ignatius, he writes:—

'The first of these basins' [that of which I have reported what I saw] 'comprises 120 great lakes and many thousands of small ones, all communicating with one another, and covering in all an area of about 10,000 square kilometers. These waters meet, as in a central reservoir, in the Saima Lake, and then clearing the Falls of Imatra, which, estimated according to the body of water, are the greatest in Europe, they throw themselves into the Wuoksi, which carries them down into the Lake Ladoga. The central reservoir of the waters of the East Tavastland basin is the Lake Päijänna, which has a length of 128 kilometers, but nowhere exceeds 20 kilometers in breadth. It pours its waters by the river Kymmene into the Gulf of Finland.

The least important of these basins is the West Tavastland one, the waters of which meet in the lake of Pyhäjärivi, near Tammerfors, and there debouches into the Gulf of Bothnia by the river Kumo. Although the basin be, as has been said, the least considerable of the three, it is one, the affluents of which give collectively a river-flow of 1200 kilometers, and they are navigable throughout nearly the half of their length.

'Amongst the other water-systems of some importance, mention may be made of the Oulujaervi, with an area of 983 square kilometers, which receives affluents from a number of lakes, some of them extending to the Russian frontier, and pouring its waters into the Gulf of Bothnia by the large river Ulea. It is calculated that the area of the basin is about 24,000 square kilometers. There is a basin of still greater extent situated further to the north. It has an area of 50,000 square kilometers, and debouches into the same gulf by the Kemi Finally, still further to the north, we find the large lake Enare, or Inari, measuring 1400 square kilometers, covered with ice during ten months in the year, and which flows into the frozen ocean.'

In connection with further details given by him, Dr Ignatius remarks:—'One may from these form some idea of the great development of inland sheets of water which there is in Finland, and of the importance of these natural means of communication, and of how connections may be established, more especially those relating to trade and commerce.'

I have given details of what has been experienced by others in descending rivers. In connection with the last citation, Dr Ignatius goes on to say: 'In general the rivers of Finland are encumbered with rapids, and consequently they are only partially navigable. They are, however, of great commercial importance, in so far as they serve for the floatage of timber, and thus bring the great forests of the interior into communication with the sea.'

The following more detailed account of the different water-systems which constitute so important a feature of the physical geography of Finland, are supplied by Dr Helm, in a little book entitled *Finnland, und die Finländer*, published in 1869.

'The sea-coast,' says Dr Helm, 'is rocky—so rocky that it may be said to be rock-bound—crags, cliffs, islands, everywhere beyond the shore, and that to such an extent that they render navigation dangerous. Through the different directions in which these rocks extend from the coast, and the different spurs and branches thrown out by the mountain-ridge, or—call it if you will—the land-ridge of Maanselkä, in the interior, arise the different water-systems of Finland. Through the arrangement of these the country is divided into five distinct river courses or water-systems.

'1. The northern water-system with the Haupt-See, Enare.

'2. The Bothnia water-system with the Haupt-See, Ulea.

'3. The south-west water-system with the Central See, Pyhäjärvi, the mouth of which is in the Gulf of Bothnia.

'4. The central water-system, with the fifty miles long Hauptbecken, or principal stream, Päijänna, which, through the Kymenfluss, flows into the Gulf of Finland.

'5. The eastern water-system, 150 miles long, with the Central See, Enonvesi, which, flowing through the Falls of Imatra, empties itself into Lake Ladoga.

'By the Saima Canal, proceeding from the Saima Lake, which is the largest in the land, the whole of these water-systems are brought into communication with the sea through the Gulf of Finland at Wyborg.

'Out of Northern America—neither in the Old World nor in the New—is there a country so rich in waters as is Finland. Were it under a milder climate these riches of water-communications would tell upon the inland transport trade and traffic; but as things are, they at present are more of an impediment or hindrance to communica-

tion, as art and skill have as yet done little to assist nature, in utilising the provision made, by making canals and connecting by short courses widely extending water-systems.

'Over the greater portion of these glorious lakes and streams rests the gloomy silence of the wilderness, and on their shores have arisen but few of the abodes of man.'

The following additional information is supplied in great part by Dr Gabriel Rein, Professor of History in the University of Helsingfors, in a brochure published by him in 1839, under the title of *Darstellung des Gross-Fürstenthums Finland:*

'The granite rocks of the mainland stretch, more especially in the south, far into the sea, and form in part numerous capes, and in part innumerable rocky islands, on the south and south-west coast of Finland, which there bear the local name of Schaeren. Navigation is thus made very perilous; but there is also found there a great many excellent havens. On the Finnish coast of the Gulf of Bothnia there are fewer of these islands, but there is a gradual shallowing of the sea, compelling the dwellers on the coast to have resource to artificial works to deepen navigable water, or to select for havens places on the extremity of the coast. By highland and mountain ranges Finland is divided into five principal water-systems, of which one finds a outlet in the frozen ocean, two in the Gulf of Bothnia, one in the Gulf of Finland, and one in Lake Ladoga.

'I. The water-system of northern Lapland, the first mentioned, separated from the others by its southern boundary of high land, has its inclination to the north. Its most extensive lake, Enare Träsk, empties itself through the Patsjoki, in the Government of Archangel, into the Gulf of Passwik, on the southern coast of the Warangerfjord. The principal river, the Tanaelf, falls into the Tanafjord in Norway.

'II. The East Bothnia water-system, to which the greater part of Lapland belongs, has a declination to the Gulf of Bothnia, and is enclosed on the north, and the east, and the south, by Maanselkä. The principal rivers are:—

'1. The Torneo, rising in the Swedish territory of Torneo Lapmark, receives, where it touches the boundary of the Russian dominions, the Muonio coming from the north, and after a course of 160 versts, upwards of a hundred miles, in a southerly direction, forming the boundary between Russia and Sweden, it falls into the sea at the town of Torneo.

'2. Kemijoki, which, flowing from a small lake on the heights, flows through Kemi Träsk, and flowing from the north-east, empties itself into the sea near the village of Kemi.

'3. The Uleåstrom, which, from the aid which, in spite of its waterfalls, it gives to the promotion of inland navigation, may be reckoned as the principal river in East Bothnia, flows from the lake of the same name, in which are collected large affluents from the Maanselkä; after a westerly course by Uleaborg, it falls into Ulea Bay.

'4. The Kyrojoki, the largest river of the southern part of East Bothnia, though not to be compared with those in the north, empties itself into the sea after a north-westerly course, to the north of Wasa.

'Although the waters of East Bothnia empty themselves by different discharges, the principal water-systems of South Finland have this as their characteristic, that a number, perhaps hundreds, of lakes united together in one common water-course, through this send their waters to the sea.

'III. The water-system of Satakunda, or Bjoerneborgs Län, is, like the last-mentioned, bounded on the north, the east, and the south by mountain ranges, and has its inclination towards the Gulf of Bothnia. It commences in lat. 63°50′ in the most northerly portion of Satakunda belonging

to Län Wasa, on the boundary of East Bothnia, forms the great Lake Estäri, flows through a great many other lakes connected with each other, sometimes by rapids, sometimes by short connecting passages. Amongst these lakes may be mentioned the Toehwesi, the largest of the whole: it receives from the north-east the waters of the Keurunselka and its tributaries; and at the point where the boundaries of Lakes Wasa, Abo, and Twastehus meet, uniting with the Lake Ruowesi, and by several other lakes and connecting reaches of water, it pours its waters into the large and noble Lake Nosijeorivi, situated some 316 feet above the level of the sea; and this again empties itself into the Pyhäjärivi, or Holy Lake, at the town of Tammerfors, by a waterfall upwards of 100 feet in height, but over which the waters pour in a continuous, unbroken sheet, falling perpendicularly throughout that height. The Pyhäjärivi is a central lake, in which, besides the masses of water spoken of as coming from the north, there meet all the north-eastern, eastern, and south-eastern waters of the district, constituting united an immense body of waters which spread themselves out in immense spacious lakes, amongst which are Lakes Wanaja, Langelmowesi, Roine, and Mallaswesi. Uniting with itself the waters of the Rautunselka, it pursues its course through several torrents and small lakes, on the boundary between the Governments of Abo and of Tawasthus, till it reaches the southern extremity of Pyhäjärivi. Out of this lake the waters collected thus from the north and from the south flow through the torrent Nokia into the Kulowesi, strengthened by many affluents from the north, which in their courses form many waterfalls, amongst others, and well deserving notice, the waterfall of Kyro, or Kyronkosti.

'From the Kulowesi flows the mighty Kumostrom, which is strengthened by new affluents from the north and from the south, amongst others by the waters of the *one hundred and seventy-one* lakes of the parish of the Mouhjörwi, which flows in a bow-shaped bend or

curve from the north-east to the north-west, and rent by several waterfalls, it falls into the sea some 30 versts, or 20 miles below the town of Bjornborg.

'IV. The water-system of Middle Finland, or the Tawastland water-system, collects itself in the great Lake Päijäne, 180 versts, or 120 miles long, and at the place of greatest expansion, 25 versts, or 17 miles broad, at a height of 253 feet above the sea. This lake receives its principal affluents from the north out of that portion of Tawastland which belongs to Wasa Län, where its most northern springs have their sources in the heights facing the boundary of Uleaborg Län, in lat. 63° 30', and from a number of pretty large lakes sending these waters to the south. Amongst others, Kolimajärwi, 30 versts or 20 miles long; Keitele, from 60 to 80 versts, or 40 to 50 miles in length, which receives from the west the waters of Lake Kiwijärwi, 50 versts, or 33 miles long. These, strengthened by many side-lakes and affluents, while still within the boundaries of the Läns of Wasa, rush in a southerly direction by the Hapawesi into the Päijäne, which, having received also the waters of the Puulawesi and several other lakes from the north-east, and the Wesijärwi from the south, pours itself through the Kalkis Strom into the Lake Routsalain, out of which flows the Iyrängo Strom, which falls into the Konnewesi. Finally, out of this lake the Kymmene, which draws off the whole body of waters, takes its flow, and flowing in an easterly direction, it traverses several other lakes, and receiving several important affluents from the north on the boundary between the Läns of Nyland and of Wyborg, it turns towards the south, and tumbling over several waterfalls on its way, amongst which may be named that of Hogfors, it takes its course towards the Gulf of Finland, into which it falls by five mouths between Lovisa and Frederickschamm.

'V. The water-system of East Finland, or that of Savolar-Karelia, takes its rise also in the Maanselkä, where it

separates the Kajanien, or eastern part of the Government of Uleaborg, from Savolar and Karelia. It has its origin in two principal streams, the one the western source, rising in 64° 4′ north, flows through Savolar, with its main direction to the south, spreads out into several important lakes, such as Oukwesi, 30 versts, or 20 miles long; the Maninkawesi; the Kallawesi, stretching 40 versts, or 27 miles in length, on which stands the town of Kuopia, and which receives from the north the waters of the Juuriswesi and its affluents, and from the south-east those of the Suwaswesi, 40 versts, or 27 miles long, and the Juojarwi, 30 versts, or 20 miles long, and many others. Continuing its course towards the south, spreading out into several lakes by the way, this water system pours through the passage at Warkhaus, where it forms a waterfall, and to the south of this spreads out its waters in the lakes Aimiswesi, Haapawesi, and Haukiwesi, and flows through the Haapawesi Strom, near by the town Nyslot into the Pihlaswesi. With these lakes in the north and the south united at Nyslot, it joins the other eastern principal branches of this great water system, which takes its rise in Karelia, part in lat. 63° 58′, and part in lat. 63° 51′, and forms, with other lakes, the Pielesjärivi, 110 versts, or 73 miles in length, and 20 to 30 versts, or 14 to 20 miles in breadth; the Höytiänen, 50 versts, or 33 miles long, and 30 versts, or 20 miles broad; the Oriwesi, 70 versts, or 47 miles long, and others; and receiving great reinforcements from all sides, it flows through the Karelian portion of the Government of Kuopia. The large bodies of waters united at Nyslot continue thence their course to the south through smaller lakes and connecting outlets, and in Great Wyborg expand into the Saima, 40 versts, or 27 miles long, and 20 versts, or 13 miles broad, in the southern extremity of which, called there Lappwesi, stands the town of Willmanstrand. And the Saima finally pours out its waters by the Muora Strom, which, tearing away through a rent in the granite rocks, forms the most remarkable waterfall in Finland—the Falls

of Imatra, six, versts or four miles below its debouchure from the Saima. Then in a south-easterly, next in a northerly, and lastly in an easterly direction pursuing its course, broken again and again by waterfalls or rapids, it pours its waters into the Ladoga, the largest lake in Europe, into which it pours by two mouths, after a course of about 170 versts, or 126 miles, a little below the town of Hexholm; and the Ladoga, by the Neva, on which stands St. Petersburg, empties itself into the Gulf of Finland and the Baltic.

'In comparison with this great water-system of South Finland, which often presents the appearance of an inland sea studded with islands, and which makes the country one of the most abundantly watered countries in the world, the water-systems which have not yet been mentioned may be looked upon as very unimportant. Amongst these, however, are the following, which demand notice:—

'1. The Aurajoki, which demands notice as the most important in an historical respect. It flows through the oldest town in Finland—Abo—and below the town, near the Fortress of Abo, now partially in ruins, it flows into the Baltic.

'2. The streamlet Karis, in Nyland, which falls into the long and narrow gulf near the town of Eknäs. This gulf is in all likelihood the waters which the Russians, when in 1311 they undertook a campaign against the Jemen or Tawaster, called the Kupetcheskia Raeka or Traffic Stream and the Eknas is the Tchornaia Raeka;

'3. The Wanda or Helsingback, on which stood the old Helsingfors, founded by the King, Gustavus Vasa, in 1550, till Queen Christina ordered the town to be removed to its present site, six versts or four miles towards the south-west.

'4. The streamlet Borga, which flows past the town of that name.

'5. Systerbach—Sestra the Finnish Rajakoti—that is boundary stream—which from 1323 to 1617 constituted

the boundary between Russia and Sweden, and after the peace settled at Nystad in 1721, separated the Government of Wyborg from the other part of the Russian empire, and which forms now the boundary between the Province of Finland and the Government of St. Petersburg.

'There are also artificial water communications by canal in Finland. The only canals made by the Russian Government hitherto are those which were constructed for military strategy after the peace of Abo, in 1743, to enable the fleet of the Saima to be brought from Willmanstrand to Nyslot without touching on Swedish territory; with this view four canals were constructed, namely—those by Kutwelentaipale, Käyhkä, Kukontiapale, and Telataipale. And these, now that all Finland is united, have lost their importance.

'Although Finland is destitute of such canals as promote commerce, much has been done to facilitate inland navigation, by clearing the rivers from obstructions, removing stones from waterfalls and rapids, and by deepening the shallower water-courses.

'By these means also has the superficial extent of the waters been diminished. A number of lakes have been drained, marshes have been dried, and extensive stretches of fertile land, suitable for agriculture, and more especially for the growth of grass, have been gained.'

Such is Finland—I shall not say a *land*, but a country, a large proportion of which is covered with water! I have endeavoured to follow literally the statements of Dr. Rein. They relate to 1839, a time, it should be noted, previous to the construction of the Saima Canal.

PART II.

FOREST ECONOMY.

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INTRODUCTION.

CONSUMPTION OF WOOD IN FINLAND.

Dr. K. E. Ignatius, who is Chief of the Staff in the Office of Statistics in Finland, reports in regard to the Forest Economy of the country:—'Forest products constitute more than half of the total value of exports from Finland. This shows of what importance the forests are for the country. It is reckoned that 64 per cent. of the entire surface, or 213,772 square kilometers, are covered with forests. But these immense resources have been wasted recklessly for centuries. That apparent dislike to forests which has been seen amongst all settlers in forest lands seems to be innate in the Finns. The practice of setting fire to the trees, in order to clear the ground, has led to the destruction of forests upon a great scale, and the conflagrations have at times swept over a great extent of country. This practice still exists, more especially in the eastern parts of the country; but the new regulations which have been issued have already contributed greatly towards putting a stop to this abuse. Amongst other causes of destruction may be reckoned first, the combustion of pines and firs to obtain tar; next, the waste of wood in fencing — in many places they enclose the smallest bits of land, and for this purpose millions of young trees

are sacrificed every year; and last of all, the reckless and excessive consumption of wood as fuel in houses, baths, furnaces, &c. According to an approximate estimate made by a Commissioner appointed to inspect the forests belonging to the Crown, there are consumed annually in Finland seven hundred and fifty-four millions of cubic feet of wood, over and above the consumption in towns and the quantity exported. This great destruction, however, has been somewhat reduced since the improvement on roads and communications, and a more lively speculation has imparted to wood a money value which it had not previously. At the same time this latter circumstance has not unfrequently had an injurious influence, for proprietors, tempted by the high prices, have sold their forests to enterprising proprietors of saw-mills, who have hasted to clear them off, stock and stem. This new devastation has engaged the attention both of the public and of the Government, which it will have to endeavour to regulate, if it be not speedily restrained by the ever increasing price of wood, and by changes on the conditions of the market.'

Such is the field of study upon which we are about to enter. To a tourist in Finland the practice of devastation may appear to be overdrawn, and the anxiety uncalled for; but it is those who know what the consumption is, and what proportion the annual cubic increase of forest product by growth bears to this, who alone can speak with authority on the subject.

CHAPTER I.

PRIMITIVE TREATMENT OF FORESTS IN FINLAND.

Dr Ignatius speaks of the practice of setting fire to the trees in order to clear the ground. This may be considered the primitive treatment of forests in Finland. It is not unknown elsewhere, as I shall afterwards show at some length. But Finland is the only country in Europe in which it is still practised extensively, supplying an opportunity of studying it in detail. As intimated by Dr Ignatius, free use has been made of the forests of Finland, as have been made of forests elsewhere, to supply fencing, building material, and fuel, and thus much wood has been consumed; but it is to the practice known as *Sartage* that the destruction of forests is mainly attributable. And this being retained here while from other countries of Europe in which it may have been practised extensively, but is now only seen occasionally, it gives a special character to the forestry of the country. But while it has been retained it is being restricted, and the most advanced forest science of the day is being applied to the management of the Crown forests. We see in this the forest treatment of the future, and in that the forest treatment of the past, which, though practised extensively, and defended on intelligible grounds, may be reckoned amongst the things which decay and wax old, and are ready to vanish away.

Section A.—Details of the Practice of "Sartage" in Finland and Adjacent Lands.

The designation *Sartage*, is that given to the practice in the Forest Science of France. In Finland I have generally heard it spoken of as *Svedanje*.

The designation *Svedanje* is Swedish, and may be attributable to the Swedish domination, and the consequent domination of the Swedish language. I have never heard it spoken of in Finland under any other name; but I have read of its being called *Roehden.* This may be some local designation, and probably a more ancient designation brought thither by forefathers of the present inhabitants on their settlement in the country.

Dr Blomqvist, the Director of the Finnish School of Forestry at Evois, informed me that *Roehden* is a word altogether unknown in Finland, and is neither Swedish nor Finnish; that there, as in Sweden, what is called in Germany *Haynen, Uberlandbrennen, Röderwaldwirthschaft, Haulengwirthschaft,* &c., and in French *Sartage,* in the commonly used Swedish language is called *Svedanje.*

The root of this word is *Sved,* a designation applied to a piece of ground so treated. The active verb is *Svedja,* used to describe the proceeding. In the Finnish language the operation is called *Paloviljelys*—composed of *palo,* burning, and *viljelys,* culture; and there is applied to it the synonymous words, *Kaskenpalto, Halmeruuki,* and *Huhtaruuki.* And the piece of ground so treated is called accordingly *Palomaa,* or *Kaski,* or *Halme,* or *Huhta.*

The clearing away of the woods thus practised is to prepare the ground for agriculture; but as much or more by the preparation of the soil as by the obtaining of space for the agriculture contemplated; and this is the peculiarity of the usage.

A spot is selected. The trees growing upon it are burned. and the seed is sown on the soil thus manured with the ashes of the trees.

Dr Gabriel Rein, in a volume entitled *Statistick Techning äf Storfurstendömet Finland,* third edition, 1853, states that from very ancient times the Finns had practised agriculture, and for centuries this has been their chief means of support; and this more so as the supplies derived from hunting and fishing became diminished. It is, says he, to the honour of the Finnish people that by them agriculture

has been carried to the most northern boundaries of their country, and has thus elevated or prepared for a higher state of civilisation the inhabitants of those regions. And there it may be seen practised by the most northern agriculturists about Altengard in Norway, where the Finns are called *Quains*, the designation Finn being there given to Laplanders.

But the soil of Finland, he adds, is naturally unsuitable for a highly developed system of agriculture, partly in consequence of the stony character of the ground, partly in consequence of the poor character of that soil requiring the labour of years to fit it for superior culture, and partly in consequence of the sparseness of the population; and such was everywhere originally the condition of the country. So far back as history reaches, the Finnish people have carried out this kind of nomadic use of the soil, a mode of culture which could be applied for a short time to one portion of the land, and then, this being abandoned, be applied to another.

In the recent cases of this practice all the trees growing on a piece of ground are cut down, are allowed to dry, and are burned. The field is then ploughed, or rather scratched, with a rude harrow, whereby it is loosened and intermixed with the ashes. It is next sown with rye, barley, or other seed. If the earth proves somewhat fertile it is sown next year with oats, and it may be afterwards with buckwheat. After this last crop has been reaped the ground is abandoned and left to rest till it be again overgrown with trees.

Ofttimes it is the case that through the culture and removal of these crops the soil becomes exhausted, and being used for pasturage, the cattle not only grazing on the grass, but browsing on seedling trees as they may make their appearance, the growth of these is entirely prevented. The forests have thus been greatly diminished, and the products of the forest being of great importance to Finland, the Government has endeavoured to limit as much as

possible this mode of culture. In consequence of this, and the introduction of improved agriculture, *Svedanje* has been greatly diminished. It is practised now to a very limited extent in the Län or district of Nyland, in which Helsingfors is situated, and in that of Åbo, and throughout the greater part of Tavastehus Län to the north-east and north of these districts, and of Wasa, on the coast of the Gulf of Bothnia, and the greater portion of the Uleaborg Län. It may be said to be in these districts practised only occasionally, as on the uprooting of clumps of trees growing in the middle of a field or meadow, or with a view to preparing pasture land for cattle. Consequently the product of *Svedanje* in these districts is small, very small in comparison with that obtained by the usual mode of agriculture. *Svedanje* is not practised now in the eastern Läns, except in Läns which are near the coast and in the south, where, for example, in the south-west of Wyborg Län it is only occasionally practised; and at Borga, Wyborg, and Nykyrka, it has been altogether abandoned. On the shores of Lake Ladoga it is strictly prohibited, in consequence of the scarcity of wood. In most other parts of the Län where it is still practised, this is done as a necessary, and at present unavoidable, means of support. The produce of it in Säckjärvi is in proportion to that otherwise obtained as 1 to 3. In other places it is as 1 to 2. In St. Michael's, further to the west, it begins to be limited. The poverty of the land, and the limited produce yielded by regular agriculture, lead to the greater use of *Svedanje*.

It is in consequence of the injurious effects of the practice that it has been thus limited.

This mode of culture has been observed to impoverish the soil so much that the forest destroyed is not always replaced by a new growth, and now only in districts where the uneven and stony condition of the ground renders it difficult to carry out regular husbandry does it still prevail.

From what is said by W. von Schubert in his 'Resa genom Sverige Norrige, Lappland,' &c., published in

Stockholm in 1823, in 3 vols. 8vo; and from what is said by Lars Levi Laestadius, in his work entitled 'Om Möjligheten och Fördelen af Allmänna Uppodlingar i Lappmarken,' published in Stockholm in 1824, it appears that the practice of burning over woodland at once to clear and to manure the ground, and from other incidental references to it, is still a recognised usage in Swedish husbandry. Though used in Norrland in Sweden as a preparation for crops of forage or grain, it is employed in Lapland more frequently to secure an abundant growth of pasturage, which follows in two or three years after the fire; and it is sometimes resorted to as a means of driving the Laplanders and their reindeer from the vicinity of the grass grounds and the haystacks of the Swedish backwoodsman, to which they are dangerous neighbours. The forest rapidly recovers itself, but it is generally a generation or more before the reindeer moss grows again. When a forest consists of pine (*tall*) the ground, instead of being rendered fertile by the process, becomes hopelessly barren, and for a long time afterwards produces nothing but weeds and briars.

It is practised to some extent in the regions contiguous to Finland, and to a district inhabited by the Karelians, a Finnish tribe divided by the frontier boundary between Russia and the Grand Duchy. M. Judrae, an able member of the Forest Service of Russia, in a narrative of a tour of inspection of the forests of Olonetz and Archangel made by him, thus writes of the practice:—

'In reading the reports of the Government Office of the Imperial Domaines, one is arrested involuntarily at a place which treats of unathorised fellings carried on without leave or sanction.

'According to these reports the population of the government consists almost exclusively of those who were Crown serfs and their children, whose requirements of wood for fuel and building are sufficiently met by the allotments made to them annually from the forests; but

these people for a long time back have been possessed with the idea that woods are of no pecuniary value, and they destroy them recklessly. When the annual allotment happens to be less than they think they require for building material—or it may be for fancy erections which they do not require—they frequently go off to the woods and cut what they want without ever applying for permission to do so. And then the question comes up—is it possible for the people to acquire at the present time any adequate idea of the necessity which there is for the conservation of the forests and the exploitation of them in a rational or scientific way? Let any one realise the case. Around all of these villages, even the smallest of them, there are forests of which the eye can see no end, they appear to be interminable; and there are depths of them to which the foot of man has never penetrated. The extent of these forests is such that to the peasantry they seem inexhaustable; while, on the other hand, the severity of the climate, the unproductiveness of the soil, and the poverty of the people, are such as to seem to call upon every one to find out for himself with a hatchet in his hand, any means of improving his condition.

'The natural condition of the country could not have called forth or exercised upon the people an effect more to be deplored.

'The peasantry here look upon wood as being in common with earth and air, fire and water, one of the elements, and as equally free to all persons; and they consequently consider that they are free to use it without stint or limit, as one of the free gifts of nature. This state of things, originating, as I have intimated, from the physical condition of the country, can only be changed or destroyed by the great change-producer, time; and the reports of the consequent destruction of the forests embrace numerous details of the extension in the country of the practice of *Sartage* or *Svedanje*. This system of felling is here very frequently met with; but if we enter into the circumstances of the case, considering, on the one hand, the

condition of the agricultural economy of the people, together with the paucity of labourers and the lack of manures, and the circumstance that the temporary culture of the fields which is thus effected supplies the only means of support to man, and, on the other hand, the great extent of the forests and the difficulty of maintaining an efficient watch over them by wardens or forest watchmen with a great extent of forest entrusted to their care, we cannot condemn the Forest Administration for not adopting effectual measures to prevent altogether this unathorised felling of trees in the forest.

'This unauthorised felling is the primary form taken by agriculture—the first step taken towards the development of rural economy. We hope in process of time to get beyond this; but to put it down by force would not be a rational course of procedure. The Northern peasant not having productive ground near his residence,nor means to improve it if he had, goes into the depth of the forest, burns down trees, and cultivates his temporary field for two or three years, or so long as its power of fertile reproduction is not exhausted—the fertility being produced by the ashes and cinders of the burnt trees. The persuasion of the peasant as to the perfect legality of such a procedure is such, that it is very doubtful whether any general measure of repression at present could remedy the evil. In order fully to understand the economic condition of this region we must go back some fifty years or so, and look at things with other eyes. I consider that this unauthorised felling originally was legal and reasonable—suitable for the place where the forests are very dense; but as a principle it admits of some formal limitation, and this, according to these reports, appears to have been attempted in the government of Olonetz in 1867. Of the system of operations carried on by this people it is said the first settlers in the country were satisfied with small plots of ground of easy cultivation, but as they increased in number they were obliged to have recourse to land which was more fertile indeed, but marshy or covered with

forests, and requiring labour to prepare it for culture, and care, and thought. Cultivation such as may be seen in civilised communities was not attainable by these people, were it only from their want of agricultural implements and manure. In the same book, on the page following, it is stated, "In these virgin soils, previously covered with forest or bush, the produce of rye in the first year was *ten* fold — frequently *twelve* fold; and there were places — generally places where there had been old dense high forests—in which the produce was *fifty* fold, and in the second year the produce was from ten to fifteen fold." '

Section B.—Forms Assumed by the Practice in other Lands.

The practice is widely diffused. 'It is a practice,' says M. Parade, formerly Director of the School of Forestry at Nancy, '*extrêmement ancienne.*' And such it appears to have been in France; but there may be claimed for it an antiquity far greater than is indicated by the practice of it in France, in Sweden, or in Finland; and amongst the conservative tribes of India it has been practised to an extent which makes the *Sartage* of France, the *Kaski* of Finland, and the *Svedanje* of Sweden appear as mere childish play. In the Canara district it is known as *Koomaree.* In a document issued by the Board of Revenue in India, in 1859, it is stated that, in some parts of Bekel, which is the most southerly of the táluks of Canara, *Koomaree* cutting forms part of the business of the ordinary ryots, and as many as 25,746, or one-sixth of the population, are supposed to be engaged in it; but to the north of that táluk it is carried on by the jungle tribes of Malai Kadeos and Mahrattas, to the number of 59,500. Here we have upwards of 85,000 men felling, burning, and destroying forests, for the sake generally of one—or at most of two crops—sometimes, but rarely, of three. After which the spot is deserted until the jungle is sufficiently high to tempt the *Koomaree* cutter to renew the process.

By this practice vast quantities of most valuable timber have been destroyed.

A good crop of hill rice, or nullet, is obtained in the first year after the consumption of the wood, a small crop is taken off the ground in the second year, and sometimes in the third, after which, as has been stated, the spot is deserted. In the south, where land is more scarce compared with the population, the same land is cultivated with *Koomaree* anew in 12, 10, and 7 years; but in North Canara, the virgin forest, or old *Koomaree*, which has not been cultivated within the memory of man, is generally selected for the operation.

'This rude system of culture,' says Dr Cleghorn, formerly Conservator of Forests in the Presidency of Madras, 'prevails under various names in different eastern countries. It is called *Koomaree* in Mysore and Canara, *Pounam* in Malabar, *Punaka* in Salem, *Chena* in Ceylon.'

The name *Koomaree* is peculiar to the Canara and the Mysore districts. It is thus described in an extract from the Proceedings of the Board of Revenue :—'The name is given to cultivation which takes place in first clearings. A hill-side is always selected, on the slopes of which a space is cleared at the end of the year. The wood is left to dry till the following March or April, and then burned. In most localities the seed is sown in the ashes on the fall of the first rains, without the soil being touched by implement of any kind; but in the tàluk of Bekal the land is ploughed. The only further operations are weeding and fencing. The crop is gathered towards the end of the year, and the produce is stated to be at least double that which could be obtained under the ordinary modes of cultivation.'

Dr Francis Buchanan, in his report of a journey from Madras through the countries of Mysore, Canara, and Malabar, published, under the authority of the Directors of the East India Company, in 1807, makes mention repeatedly of the practice in these countries under the designations of *Cotu-cadu*, *Cumri*, and *Ponna*. Of the

mountainous district of the basin of the Cauvery, he writes:—'In this hilly tract are a number of people, of a rude tribe called Soligas, or Soligaru, who use a kind of cultivation called the *Cotu-cadu*, which a good deal resembles that which in the eastern parts of Bengal is called *Jumea*. In the hot season the men cut the bushes that grow on any spot of land on the side or top of a mountain, where between the stones there is a tolerable soil. They burn the bushes when these have become dry, and leave to the women the remainder of the labour. When the rains commence, these, with a small hoe, dig up the ground to the depth of three inches. They then clear it of weeds, and next day sow it broadcast with *ragi*, here and there dropping in a seed of *avary*, *tovary*, mustard, maize, or pumpkin. The seed is covered by another hoeing. A woman can in one day hoe ten cubits square, and on the next can sow it. The sowing season lasts about two months, so that the quantity sown in a year by every woman may be estimated at somewhat less than the sixth part of an acre. The custom, however, is for all the people of one village to work one day at one family's ground, and the next day at another's, in regular succession. The villages in general contain four or five families. The women perform also the whole harvest.

'These people have also plantain gardens. To form one of these they cut down the bushes, and form pits with a sharp stick. In each of these they set a plantain sucker, and ever afterwards keep down the grass and bushes, so as to prevent them from choking the garden.'

Of a short journey from Bellata Angady, in Canara, he writes:—'I went a short journey to Jamal-Abad. . . . The country through which I passed to-day was almost entirely covered with wood; but much of it has a good soil, and might be watered by means of the small river which we twice crossed. . . . In this neighbourhood the hills that are cultivated after the *Cotu-cadu* or *Cumri* manner are all private property. The *Mulucaras*, or proprietors, have alienated the whole right of cultivating

them to a rude tribe, called *Malayar* or *Malay-cudies*. The *Malayar*, who dwells on any hill of this kind, has the exclusive hereditary right of cultivating it; but while not occupied by this labour he and his family must work for the proprietor, *Mulcara*, at the allowance of provisions usually given to slaves. The Malayar may give up his possession when he pleases, which secures him from being ill-used by the proprietor; for such people on an estate add greatly to its value. They work for their master ten months in the year; but have six or seven miles to come and go from their hills to their master's fields; they labour only six hours in the day. In this neighbourhood no tax is imposed on this kind of land; but in some districts the Malayars pay annually a small sum to Government for each hill.

'The following is the manner in which this sort of cultivation, called *Cumri*, is performed. In the beginning of the dry season the Malayar cuts down all the trees and bushes from a certain space of ground, and before the rains set in he burns them, the ground is then dug with a sharp bamboo, and sown with shamay (*panicum miliare*), ragi (*cynosurus corocanus*), rice, and various cucurbitaceous plants. The grains are sown separately; but seeds of the cucurbitaceous fruits are mixed with all the farinaceous crops. With the ragi are also mixed the seeds of hibary (*cytisus cajan*), and of abary (*dolichos lablab*). Next year another piece of ground must be cleared, the former not being fit for cultivation in less than twelve years. In Tulava, this is the only kind of cultivation of dry grains, although much of the ground seems fit for the purpose; but the natives have a notion that no high ground can produce anything, unless a great deal of timber has been burned upon it.

'They therefore consider the greater part of the country totally useless, except for pasture or hay, and very little of it produces the proper grass. One kind of grass only that is produced in Tulava is eatable; and when I proposed to the natives to destroy the bad kinds, and sow the seed of

the good, they were filled with astonishment at what they considered as the extravagance of the project. Where the hills are not too steep for the plough, I am persuaded that this might be done to great advantage; and the quantity of live stock and manure might thus be quadrupled.'

Of this practice there are, as has been intimated, frequently recurring notices in the report. Thus, writing of the northern parts of Canara, Dr Buchanan states: 'In the hilly parts of the country many people of a Mahratta extraction use the *Cumri* or *Cotu-cadu* cultivation. In the first season, after burning the woods, they sow ragi (*cynosurus*), tovary (*cytisus cajan*), and harulu (*ricinus*). Next year they have from the same ground a crop of shamay (*panicum miliare* Lamark.) These hills are not private property, and pay no land-tax; but those who sow them pay, for the right of cultivation, a poll-tax of half a pagoda, or nearly 4s. On account of poverty, many of them are at present exempted from this tax.'

Writing again of Soonda, he says: 'The number of people employed in the *Cumri*, or *Cotu-cadu* cultivation, amounts to 2418, who pay yearly 954 half pagodas, or 3s. 2¼d. a-head. It is supposed by the revenue officers that in this manner 1900 more people might find employment.'

Of a caste called Budugar, inhabiting the hilly country between Dari Nayakana, Cotay, and the province of Malabar, he tells that they not only practice the *Cotu-cadu* cultivation, but have also ploughs, which seems to indicate that with it they combine a higher cultivation.

Of tribes living on the hills west from Coimbatore, he tells of the Todear that they cultivate with the plough and pay rent for their fields; but of the others, the Malasir, the Mudugar, and the Eriligaru, that they cultivate after the *Cotu-cadu* fashion.

Of the Malasirs, he tells that they live in small villages of five or six huts, situated in the skirts of the woods on the hills of Daraporam, Ani-Malaya, and Palighat; and that they speak a mixture of the Tamul and Malayala

languages. 'They are a better-looking people than the slaves, but they are ill-clothed, nasty, and apparently ill-fed. They collect drugs for the trader, to whom they are let; and receive from him a subsistence, when they can procure for him anything of value. He has the exclusive right of purchasing all that they have for sale, and of supplying them with salt and other necessaries. A great part of their food consists of wild yams (*dioscoreas*), which they dig when they have nothing to give to the trader for rice. They cultivate some small spots after the *Cotu-cadu* fashion, both on their own account and on that of the neighbouring farmers, who receive the produce, and give the Malasirs hire. The articles cultivated in this manner are ragi (*cynosurus corocanus*), avary (*dolichos lablab*), and tonda (*ricinus palma Christi*). They are also hired to cut timber and firewood. In this province they pay nothing to Government.'

Writing of Cherical in Malabar, he tells:—'The hill lands that have been cleared are called *Parumba*, as in the south; but there are certain hills that are covered with woods and bushes, and called *ponna*. The natural produce of these is of no value; but once in ten years the bushes are cut and burned. The ground is then hoed, and sown with a kind of rice called *coiwilla;* along with which are intermixed some tovary (*cytisus cajan*), and cotton. In fact, this cultivation is the same with the *Cotu-cadu* of Mysore; and is said to be that which is chiefly used in the interior parts of Cherical and Cotay-Hutty; that is to say, in the northern parts of Malayala, where the cultivation of the valleys is much neglected. This kind of land pays four-tenths of the produce as rent (*varum*), of which one-half is equal to the *negadi*, or land tax.'

Of Cherical he tells that 'all the eastern parts are continuous forest, interspersed occasionally by slips of low, rich rice-lands from 100 to 300 yards broad.' And again: 'after deducting the third part of Cherical, too barren for cultivation, and the small quantity of low rice land, all the

remainder, or at least half of the country, might probably be formed into plantations or gardens. The plantations at present rated in the public accompts are 19,048.' And again: 'The hill land not occupied by these gardens is commonly once in ten or twelve years cultivated after the *ponna* fashion, as I have described at Tellichery. The principal grain sown is the hill rice, on which the inhabitants of the interior chiefly depend for a subsistence. There are also sown some shamay (*panicum miliare*), ellu (*sesamum*), and pyru (*legumes*); and with every crop raised on this kind of ground some cotton seeds are mixed.'

Marsden, in his *History of Sumatra*, tells that the inhabitants of that island have no settled land for their tillage, but cut down every year a part of the ancient forests of the country, and ameliorate the soil by the ashes of the trees which they burn upon it. 'I could never,' says he, 'behold this devastation without a strong sentiment of regret. Perhaps the prejudices of a classical education taught me to respect those aged trees as the habitation of an order of sylvan deities, who were now deprived of their sustenance. But, without having recourse to superstition, it is not difficult to account for such feelings at the sight of a venerable wood, old as the soil it stood on, and beautiful beyond what the pencil can describe, annihilated for the mere temporary use of the space it occupies.'

In Ceylon the same practice is followed. Sir James Emmerson Tennant, in his interesting work on that island, writes (vol. ii., p. 473):—

'Drawing near to Batticoloa, large spaces in the forest, of 200 and 300 acres, suddenly appeared, cleared of the timber, and enclosed by rustic fences, with a few temporary huts run up in the centre, and all the surrounding area divided into patches of Indian corn, coracan ground, and dry paddy; with plots of esculents, and curry stuffs of every variety—onions, chillies, yams, cassava, and sweet potatoes; while cotton plants, more or less advanced to

maturity, are scattered throughout the whole space which had been brought into cultivation.

'The process of *Chena* cultivation, in this province, is uniform and simple. The forest being felled, burned, cleared, and fenced, each individual share is distinguished by marks, huts are erected for the several families, and in September the land is planted with Indian corn and pumpkins; melon seeds are sown, and cassava plants are put down round the enclosure. In December the Indian corn is pulled in the cob, and carried to market; and the ground is resown with millet, and other kinds of grain, chillies, sweet potatoes, sugar cane, hemp, yams, and other vegetables, over which an unwearied watch is kept up till March and April, when all is gathered and carried off. But as the cotton plants, which are put in at the same time with the small grain, and other articles that form the second crop after the Indian corn has been pulled, require two years to come to maturity, one party is left behind to tend and gather, whilst their companions move forward into the forest to commence the process of felling the trees, and forming another *Chena* farm.

'The *Chena* cultivation lasts for but two years in any one locality. It is undertaken by a company of speculators under a licence from the government agent of the district, and a single crop of grain having been secured, and sufficient time allowed for the ripening and collecting of the cotton, the whole enclosure is abandoned, and permitted to return to jungle, the adventurers moving onward to clear a fresh *Chena* elsewhere, and take a crop off some other enclosure, to be in turn abandoned like the first: as in this province no *Chena* is considered worth the labour of a second cultivation until after an interval of fifteen years from the first harvest.

'During the period of cultivation great multitudes resort to the forests, comfortable huts are built, poultry is reared, thread spun, and chatties and other earthenware vessels are made and fired; and by this primitive mode of life—which has attractions much superior to the monotonous

cultivation of a cocoa-nut garden, or an ancestrial paddy farm—numbers of the population find the means of support. It likewise suits the fancy of those who feel repugnant to labour for hire, but begrudge no toil upon any spot of earth that they can call their own; when they can choose their own hours for work, and follow their own impulse for rest and idleness, it is impossible to deny that this system tends to encourage the natives in their predeliction for a restless and unsettled life, and that it therefore militates against them attaching themselves to fixed pursuits, through which the interests of the whole community would eventually be advanced. It likewise leads to the destruction of large tracts of forest land, which, after conversion to *Chena*, are unprofitable for a long series of years; but, on the other hand, it is equally evident that the custom tends materially to augment the food of the country (especially during periods of drought), to sustain the wages of labour, and to prevent an undue rise in the market value of the first necessaries of life. Regarding it in this light, and looking to the prodigious extent of forest land in the island, of which the *Chena* cultivation affects only a minute and unsaleable portion, it is a prevalent and plausable supposition, in which, however, I am little disposed to acquiesce, that the advantages are sufficient to counteract the disadvantages of the system.'

In a number of *The Cornhill Magazine* issued lately (March 1883), is a graphic detailed account of the practice as followed by the hill tribes of Burmah. But it is a practice by no means confined to Asia. In South Africa something of the kind may be seen. Thus do Bechuanas in some districts prepare virgin soil for culture. Thus do the Boors burn down the Rhenoster bush, herbs, and arborescent shrubs growing on the ground, as a preliminary step towards bringing it under cultivation, converting it from *veld* into *land*. And in the vicinity of Uitenhage I have seen a portion of primæval forest cultivated in true *Koomaree* style by Kaffirs, with the consent of the pro-

prietor, for which a consideration had been given. And the general practice of burning the *veld*, which is there followed—whether applied to grass, or to other herbage and bush—is the same in principle; but what is now under consideration is the application of it to forests and trees. The practice may be said to be universal.

'When multiplying, man had filled the open grounds along the margin of the rivers,' says Marsh, in his valuable volume entitled *The Earth as Modified by Human Action*, 'and the lakes, and the sea, and sufficiently peopled the natural meadows and savannahs of the interior, where such existed, he could find room for expansion and further growth only by the removal of a portion of the forest that hemmed him in. The destruction of the woods, then, was man's first geographical conquest, his first violation of the harmonies of inanimate nature. Primitive man had little occasion to fell trees for fuel, or for the construction of dwellings, boats, and the implements of his rude agriculture and handicrafts; windfalls would furnish a thin population with a sufficient supply of such material, and if occasionally a growing tree was cut, the injury to the forest would be too insignificant to be at all appreciable. The accidental escape and spread of fire, or possibly the combustion of forests by lightning [?] must have first suggested the advantages to be derived from the removal of too abundant and extensive woods, and, at the same time, have pointed out a means whereby a large tract of surface could readily be cleared of much of this natural encumbrance. As soon as agriculture had commenced at all, it would be observed that the growth of cultivated plants, as well as of many species of wild vegetation, was particularly rapid and luxuriant on soils which had been burned over, and thus a new stimulus would be given to the practice of destroying the woods by fire, as a means of both extending the open grounds, and making the agriculture of a yet more productive sort. After a few harvests had exhausted the first rank fertility of the virgin mould, or when weeds and briars and the sprouting roots

of the trees had begun to choke the crops of the half-subdued soil, the ground would be abandoned for new fields won from the forest by the same means, and the deserted plain or hillock would soon clothe itself anew with shrubs and trees, to be again subjected to the same destructive process, and again surrendered to the restorative powers of vegetable nature. This rude economy would be continued for generations, and, wasteful as it is, it is still largely pursued in Northern Sweden, Swedish Lapland, and sometimes even in France and the United States.'

In a foot-note he adds :—'In many parts of the North American States the first white settlers found extensive tracts of their woods of a very park-like character, called "oak openings," from the predominence of different species of that tree upon them. These were the semi-artificial pasture-grounds of the Indians, brought into that state, and so kept, by partial clearing, and by the annual burning of the grass. The object of this operation was to attract the deer to the fresh herbage which sprang up after the fire. The oaks bore the annual scorching, at least for a certain time ; but if it had been indefinitely continued, they would very probably have been destroyed at last. The soil would have been much in the same condition, and would have needed nothing but grazing for a long succession of years to make the resemblance perfect. That the annual fires alone produced the peculiar character of the oak openings, is proved by the fact that as soon as the Indians had left the country young trees of many species sprung up and grew luxuriantly upon them.' For a very interesting account of the oak openings, he refers to "Dwight's Travels," vol. iv., pp. 58–63.

Leaving the prehistoric times of North America, and taking up the present, the case is more clear.

And in the British Dominion of North America the same operation, there designated clearing, may be seen carried out systematically, ruthlessly, and recklessly, in a

somewhat modified form, adapting it to the circumstances of the case, to clear lands of forests, that it may be used for agriculture.

In a work entitled "Historical and Descriptive Sketches of the Maritime Colonies of British America," by John M'Gregor, published in 1828, in a sketch of the progress of a new settled location upon uncleared forest land, we are told 'the first object is to cut down the trees, which is done by cutting, with an axe, a notch into each side of the tree, about 2 feet above the ground, and rather more than half through on the side it is intended the tree should fall. The lower sides of these notches are horizontal, the upper make angles of about 60°. The trees are all felled in the same direction, and after lopping off the principal branches, cut into 12 feet or 15 feet length; the whole is left in this state until the proper season for burning arrives, generally in May, when it is set on fire, which consumes all the branches and small wood. The larger lops are then either piled in heaps and burned, or rolled away to make fencing stuff.' There follows an account of the agricultural operations which succeed, but it is the destruction of the forest, as a preparation for these, with which alone we are concerned here.

Sometimes there is combined with such operations as have been detailed, the preparation of potash from the residuum of the wood consumed.

The making of salts is toilsome and laborious, but is considered profitable, especially where it is carried on in conjunction with clearing.

The extent of land which has been denuded of forest by such clearings is immense.

CHAPTER II.

DISCUSSION OF THE EVILS OF "SARTAGE" IN INDIA.

WHATEVER may justify and recommend the practice of *Sartage*, in certain circumstances, the practice is not productive of unmixed good.

By Dr Ignatius it is stated, in the passage I have cited, that the practice has led to the destruction of forests upon a great scale, and the conflagrations have at times swept over a great extent of country. It may be questioned whether, even in such occurrences, the good does not preponderate over the evil; and it may be admitted that this must depend on the conditions under which these happen. I shall revert to this subject ere I close; but there are other consequences dependent on conditions under which it is practised, which deserve some consideration.

It is a practice which seems to be generally condemned by those who have taken a comprehensive view of its results, though there are those who have done so who approve, or, at least, do not feel free, to condemn its application to forests in certain circumstances. Sir J. E. Tennant questions whether the alleged advantages resulting from it in Ceylon, suffice to counterbalance evils consequent upon the practice of it, and in India some of its demerits have been fully discussed. There, in 1847, under date of 31st August, Mr T. S. Blane, Collector of Canara, wrote to the Board of Revenue:—

'The practice of *Koomaree* cultivation is one of so wasteful and improvident a nature that it appears to me it ought not to be tolerated, except in a very wild

and unpeopled country; and the time seems to have arrived when it would be most advisable to place it under considerable check and regulation, if not entirely to prohibit it. This latter course, I must observe, the authorities in Mysore have, only within this last year, thought it necessary to adopt. It was never permitted under the Rajah's government, and can only be said, therefore, to have been in operation for twelve or fifteen years at most; yet so rapidly has it increased, that the superintendent of the Nuggur division, with whom I have had much conversation on the subject, has determined on putting a stop to it, with a view to the preservation of the woods which still remain.

'I am not disposed at present to recommend its entire prohibition; but I think it would be well to do so in all places accessible to the sea-ports, where timber and firewood could be brought down, and to place it under regulation in every other part of the district. The revenue paid on this destructive kind of cultivation is very trifling, and if the wood were preserved in accessible spots, the duty upon the export of timber and firewood would, under proper regulation, exceed it ten-fold. I have particularly noticed the destruction which has taken place of forest on the hills above the fine port of the Tadri, where it would have been very valuable, from its vicinity to the coast. The forests which have here been felled and burned, and the magnificent trees which have been left to rot on the ground, would have supplied the market of Bombay with firewood for years. The same fact has been noticed by Mr Forbes, my head-assistant.

'I have referred above to the manner in which the practice of *Koomaree* cultivation has increased of late years. It was formerly confined entirely to the race of wild and uncivilised people who dwelt habitually in the jungles; but others have since taken it up, and many of the ryots from the plains, and others who have come from the Mysore and Mahratta country, have adopted it as a means of livelihood. There is little doubt, also, that the

prohibition of this practice in the Mysore country will drive a great many of those who have carried on their operations in the forests of that country into Canara, and the destruction will thus be carred on more rapidly than ever, until the woods are finally exhausted. Independent of these considerations, it is not a pursuit in which it is at all desirable to encourage the people readily to engage in. It has, no doubt, some attraction for those who are impatient of control, and are fond of a wild, roving life; but it leads to unsettled habits, and takes many away from the regular cultivation of a fixed spot.'

Mr G. S. Forbes, Sub-Collector of Canara, referred to by Mr Blane, had written as follows:—

'The third source of consumption I have to mention arises from the cultivation of *Koomaree*, which, as you are aware, is carried on upon tracts where the trees have been previously felled and burned. The value of timber thus destroyed by one man, calculating it by the number of logs it might have yielded, is at least twenty times as great as the value of the crop of *ragi* obtained in the two years that cultivation is continued; and the amount of duty which the trees would have yielded if exported as firewood, bears the same proportion to the paltry sum paid to Government for the clearing. To abolish this species of cultivation would deprive a great number of persons of their accustomed means of support, and I have only therefore to suggest that the cultivation of *Koomaree* be forbidden in all localities where trees for timber or firewood are likely to be felled; such localities may be determined by the means of carriage which exist. On hills and on tracts distant from the lines of water carriage, the timber consumed could not be turned to any other account (it being always understood that no teak or sissoo, &c., should be touched.) The above remarks apply chiefly to the forests below Ghats, and which extend several miles from the hills towards the sea, and from the Goa boundary to the river Tadri, which bounds the Ankola táluk.'

Some ten or twelve years later, towards the close of 1858, Mr Beaumont, manager of the Beypur Iron Works, called the attention of the authorities to the loss to Government, by the practice then prevailing extensively in Malabar, 'of cutting down maiden forests by the Malai-Karen and native landowners for the purpose of cultivation. 'The grains usually planted,' says he, 'are *paddy* (rice), *shama* (millet), and *tomara*. For the two last Government receive no tax. For the first (*paddy*), which is principally sown, it is true that the circar receives the usual *nigady*, but, for the following reasons, this affords to the country an inadequate return for the destruction of forests, which, in later years, would prove of immense value. The tract of land denuded of forest can, from the want of irrigation, *only be cultivated profitably once in five, or sometimes in twenty years.* Thus does the country receive but one year's tax out of, say nine, upon ground so cleared. It will, upon the other hand, readily be perceived that these wholesale depredators, being unable to cultivate the same land except during one year, will remove to another locality where maiden jungle stands, and there resume the work of devastation. It is unnecessary for me to enumerate, to one so well acquainted with the district, the numberless tracts of magnificent forest which, during my short residence in Malabar I have seen swept from existence by the process; but I cannot refrain, whilst one opportunity offers, of recording my decided opinion that unless Government take some step to check this system of wanton destruction, in a very few years the chief portion of these magnificent forests will present little but a barren waste, studded with the finest trees which can adorn or fertilise the district in which they stand.'

Under date of 7th December 1858, Dr Cleghorn, Conservator of Forests under the Madras Government, reported as follows:—

'In E.M.C., 28th July 1857, I was directed to write a full report upon this wasteful system. I have paid

much attention to the subject; and after consultation with revenue officers, coffee-planters, &c., I annex the opinions of Mr T. L. Blane, Collector of Canara; Mr G. S. Forbes, Sub-Collector of Canara; Mr Thomas Cannan, coffee-planter; and Mr T. Beaumont, of Beypur, which serve to illustrate the general views of the collectors of revenue, coffee-planters, and the energetic agent of the Beypur Iron Works.

'It is not possible, nor is it desirable, to suppress the *Koomaree* cultivation altogether, as the growth of the various millets is necessary to the aliment of certain classes of people; but I think it most important that it should be *greatly limited*, as suggested by Mr Blane, and *not permitted* on the banks of navigable rivers or the sea-shore, close to trunk roads, or in any locality where superior timber exists. The revenue arising from one rupee per acre is trivial compared with the value of the wood lost to the State, and it is well known that in the much frequented valleys of the Ghats much *Koomaree* takes place without the knowledge of the revenue officers, European or native.

'In every case I think an application for a specified amount of *Koomaree* land should be made; and where *Koomaree* takes place without sanction, the cultivator should be severely fined. In this way the destruction of virgin forests has been brought under, both in the Mysore and in the Mahratta country. I do not here allude to the private lands of Mahratta, with which I have nothing to do.'

The statements of Mr Blane and Mr Forbes have been given. The following is the opinion of Mr Thomas Cannan, coffee-planter, which is cited:—

'With regard to *Koomaree* cultivation, the Government, in my opinion, is the greater loser, there being very seldom more than one crop of *ragi* taken from one patch, which, if cultivated with coffee, would have yielded something every year for half a century, in the way of rent or tax.

In an old *Koomaree* the jungle trees grow up again, but they are unfit for building purposes; and in this respect settlers in the country are put to expense and inconvenience, as well as the Government, in their building operations, and coffee-planters generally find their planting operations brought to a very unsatisfactory and abrupt termination by a *Koomaree*, on which I have never been able to get coffee to grow yet. In Nuggur, where *Koomaree* cultivation was prohibited, stringent regulations in regard to the cutting of timber were issued at the same time. Every person requiring wood was required to apply before felling it; the cultivator had not to pay for it, but the non-cultivator had, and I am of opinion that these measures have operated pretty well. The more I think of *Koomaree* the more surprised I feel that it has been tolerated for such a length of time. It is carried on by a set of savages, in every sense of the word, who would be much more profitably employed on public works or on coffee plantations.'

This testimony of Mr Cannan is in accordance with what has been observed by others, including, I believe, all those who have given attention to the subject. But Dr Cleghorn speaks alike of 'the axe of the coffee-planter and of the *Koomaree* cultivator,' as having made extensive, and even wanton havoc, devastating a large portion of the area of the primæval forest.

In regard to clearings for coffee plantations, Dr Cleghorn states in another report:—

'The successful cultivation of the coffee plant is exceedingly remarkable, and applications for grants of forest land pour in upon the revenue authorities. In the Sispara, Perambady, and Sampajee, vast clearings are being made. In the Kumur-Ghat six large plantations may be seen; and there are very large and numerous holdings above thirty in the Wainád, which from year to year will increase. The plant has succeeded admirably in

Mysore; and there are patches of cultivation in Madura, and in North Canara. I may observe that in granting forest land it seems to me that while the destruction of forests (teak, ebony, and poonspar excepted) for *bona-fide* cultivation may be considered legitimate, yet the preservation of the fringe along the crest of mountain ridges is of special importance in a climatal point of view; and this should never be given over to the axe. As these mountain crests are not suitable for the growth of coffee the restriction cannot be complained of.' And he goes on to say:—'I here beg to annex extract of letter to the Collector of Coimbatore, dated 2d October 1857, which contains my views in reply to a reference on this important matter: "The higher sholas clothing the Ghats on both sides are of the utmost importance, and the climate is believed to suffer the greatest detriment from their removal. I would therefore suggest that the high wooded mountain tops, overhanging the low country should be preserved with rigid care; the forest there should not be given over to the axe, lest the supplies of water may be injured. It is the opinion of many persons, in which I concur, that the vast clearings which have taken place have had a share in producing the irregularity of the monsoon, which has of late years been so much complained of in Coimbatore. In order that the course of the rivulets should be overshadowed with trees, I conceive that the hills should be left clothed to the extent of about half their height from the top, leaving half the slope and all the valley below for cultivation. This available portion would far exceed in extent the higher ridges, which should be conserved.

'"It seems to me that the immense tracts of virgin forests, in the rich valleys of the Kundahs, are eminently suited for coffee cultivation; and the removal of the forest *there* would not be attended with the same disadvantage as on the eastern Ghats, where the drier climate does not admit of the same efforts at speedy reproduction. If it be thought desirable to lay down a general rule in regard to the limits of elevation within which clearing for coffee

cultivation should be allowed, I would specify from about 2,500 to 4,500 feet, this being, I understand, the extreme range within which coffee planted on a large scale is found to thrive. It is of importance to give *every facility* for the cultivation of coffee; but it is desirable to limit the clearing of those situations where this peculiar shrub can be grown with advantage. I have observed some clearings where the ground is so precipitous that it is extremely improbable that the soil can last many years. It may be urged that, in general, people are sufficiently alive to their own interests to select only those sites which are in every way eligible; but from the inexperience of many who engage in coffee planting, it seems desirable to lay down some rule. I need only point to the vast amount of land cleared and subsequently abandoned, both in this country and Ceylon, either before or after planting.'

In regard to this report by Dr Cleghorn, it was stated in an order of Government subsequently issued:—'The Government fully concur in Dr Cleghorn's views as enumerated in this paragraph, which may be stated in a few words to be, that while it is desirable to give every encouragement to the extension of coffee cultivation, the destruction of timber must be prevented by restricting grants of coffee lands to places where the shrub can be grown with advantage; and at the same time the denudation of the higher ridges and slopes of hills which, if allowed, may result in a serious diminution of the rainfall, should be absolutely prohibited.'

Attention having thus been directed to the subject, it was observed that a wasteful destruction of forests similar to what had there been occasioned by the extension of coffee plantations was going on elsewhere, though to a somewhat less injurious extent. Captain Beddam, who afterwards acted as officiating Conservator of Forests in the Presidency of Madras, while Dr Cleghorn visited England on sick leave, had, in the year before, in a report on the Pulmy Hills, described devastations committed in the

formation of plantain gardens, and Dr Cleghorn reported: 'The green hills have been stripped of their woods, and much of their beauty has departed. The reckless cutting there, however, has been rigorously checked by the Collector, under orders from Government.'

This, however, was not deemed sufficient, and the Collector of Madura was called on to report whether he had succeeded in putting an entire stop to the devastation previously carried on on the slopes of the Pulmy Hills by the formation of these plantain gardens.

While this was being done, the practicability of carrying on such operations without detriment to the forests, was demonstrated by the establishment of tea and chinchona plantations in connection with the forest administration.

In reference to the report made by Dr Cleghorn, it is stated in the minutes of consultation, under date 30th March 1859:—'The Conservator responds to the call made upon him in E.M.C., 28th July 1857, to report fully on the *Koomaree* system of cultivation. Dr Cleghorn has consulted various persons whose opinions on the subject may be considered to bear weight, and has come to the conclusion that it is neither possible nor desirable to suppress *Koomaree* cultivation altogether, but that it should be carried on under stringent regulations, the chief of them being that a previous application for a specified extent should be made in every case, and that any unauthorised operations should be punished by severe fine; and that it should be wholly prohibited and stopped in the neighbourhood of trunk roads, navigable rivers, or the sea-shore, as well as in all localities where there is valuable timber. These views appear to the Governor in Council to be judicious and practical; but before issuing final orders on the subject, he resolves to refer the question for the consideration of the Board of Revenue, who have had the question of *Koomaree* under their consideration at various times within the last few years. Whatever rules may be established, the active co-operation of the Revenue Department will be necessary to enforce them.'

In the extract proceedings of Board of Revenue, under date 16th April 1859, it is stated:—

'The *Koomaree* in Bekal has been shown to be peculiar. It is chiefly Wargadar *Koomaree*, and the extent of land for which *shist* is paid is specified in the *pattah*, and the Wargadar enjoys twelve times as much, on the supposition that he will go over the whole area in twelve years, though he now cultivates it more quickly;' and some other modifications of this is practised in particular districts. Some slight modifications of the regulations were suggested, but the restrictions generally were approved.

It was felt, however, to be a matter involving the interests of a very great number of people, both directly and indirectly, and the Governor in Council, before passing a final order, transmitted a copy of the minute of the Board of Revenue to the Conservator of Forests, for his opinion on several questions raised.

In the minutes of the Board of Revenue it was stated:—

'In some parts of Bekal, which is the most southerly of the táluks of Canara, *Koomaree* cultivation forms part of the business of the ordinary ryots, and as many as 25,476, or one-sixth of the population, are supposed to be engaged in it; but to the north of that taluk it is carried on by the jungle tribes of Malai Kadeos and Mahrattas, to the number of 59,500.

'6. In Fasli 1266, the area under *Koomaree* cultivation throughout the whole district was 17,084 acres, of which 8556 acres were Sarkar *Koomaree*, that is *Koomaree* that is in forests not claimed by the owners of estates; and 8528 acres, of which 5983 acres were within the limits of the Bekal táluk were attached to wargs, or holdings of proprietors.

'7. The question, whether it is expedient to allow this species of cultivation, first came under discussion in reference to the report of Dr Gibson to the Government of Bombay, which was referred to Mr Blane, Collector of

Canara, for his observations. In accounting for a growing scarcety of timber, Mr Blane noticed, among the most influential causes, the increase in the *Koomaree* cultivation, which bid fair, he then considered, to destroy the whole of the large virgin forests within a short time. He expressed his opinion that it should either be placed under considerable check and regulation, or entirely prohibited, as had been done in Mysore. Mr Blair, a former collector, he stated, had, in 1843, issued a proclamation directing that five valuable kinds of timber, viz.:—teak, pún, blackwood, jack, and sandal should be preserved in the Government forests; but this, Mr Blane states, had practically no effect, inasmuch as the timber-merchants continued to fell the timber wherever they found it, on the plea that they cut it from private jungles, and had obtained the permission of the owners to do so. To defeat this subterfuge, Mr Blane had directed that when jungle was claimed as private property, the right must be established before timber is cut. The clearance of the jungle, so injurious in many respects, had been attended with one great advantage. According to all reports it had diminished the prevalence of fever. On this account, principally, he had confined his recommendation to the confirmation of his prohibition of the felling of the five superior kinds of timber, and to the preservation of the jungle in spots near the rivers, or the sea-coast, where, from its position, the timber could be easily made available, and the inferior kinds of wood might be allowed, under proper regulations, to be cut as firewood for export.

'8. On this report being laid before Government, they, agreeably to the recommendation of the Board, authorised the Collector of Canara to restrict the cultivation of *Koomaree* to "such places, and to such an extent, as might, in his opinion, be expedient for the preservation of the forest, and the general welfare of the province." He was also instructed to assert the right of Government to all forest lands to which a title cannot be clearly established by private individuals.'

The following are copies of the order of the Government issued in regard to the extract of minutes, and of the report of the Conservator of Forests given in reply:—

'Order of Madras Government, June 1859.

'1. Before passing a final order on this paper, the Governor in Council resolves to transmit a copy to the Conservator of Forests for his opinion as to the sufficiency, as regards the Conservancy Department, of the means proposed by the Board (in pars. 43 to 47) for checking the practice of *Koomaree* cultivation.

'2. The chief mischief of this practice is found in its destruction of timber; but the Governor in Council wishes to have Dr Cleghorn's opinion whether, in the existing state of the forests of Canara, it is important to stop it on that account in localities where valuable timber, such as teak and blackwood is not met with. In Bekal táluk it is stated (par. 44) that there is no valuable timber; but in Supah and Yellapur, which contain a large quantity, it might be expedient to make the prohibition even more absolute than the Board advise (par. 47).

'3. Par 43. With regard to considerations apart from the Conservancy, the Governor in Council is not prepared fully to adopt the reasons advanced against the prohibition of the practice. It is urged that this sort of tillage affords a livelihood to wild races who can only gradually be brought to regular habits of agricultural industry. The Government have strong doubts whether the way to teach industrious habits to such classes is thus to tolerate and even encourage the continuance of contrary habits. It appears, too, that there must be something very profitable or otherwise very attractive in *Koomaree* cultivation, as a very large number of ordinary ryots appear to be engaged in it—nearly 26,000 in the single táluk of Bekal (par. 5).

'4. Again it is stated that the grain thus obtained is necessary to the subsistence of the population. It may be granted that the grain is necessary, but it does not follow that this mode of raising it should be so; and the

Governor in Council wishes for Dr Cleghorn's opinion whether it would not be better that land required for cultivation should be permanently cleared and cultivated.

'Lastly, the Government will be glad of Dr Cleghorn's opinion whether *Koomaree* cultivation has diminished the prevalence of fever, as stated in the 42d par. It appears to Government that it embraces opposing influences in that regard—some adverse to the production of malaria, others favourable to it; while permanent clearings appear of more unmixed advantage.

'5. In Mysore, it is stated, *Koomaree* has been wholly prohibited; and it has been very nearly also in the forests of the Bombay territory. It is matter for consideration in the opinion of Government whether it may not properly be so in Canara also.

'6. Dr Cleghorn will also be requested to inform Government whether the kind of cultivation in Malabar called *Punam* resembles *Koomaree* in respect to the temporary and successive clearing and abandonment of land, or whether the land is there cultivated more permanently. If the latter is the case, it would seem to afford an additional argument for putting a stop to *Koomaree*.

J. D. BOURDILLON,
Secretary to Government.

'From Conservator of Forests to Secretary to Government.

'17th August 1859, No. 755.

'1. I have the honour to acknowledge receipt of the Pros. of Government, 1st June 1859, No. 737, enclosing Ex. Pros. Board of Rev., No. 1350, 16th April 1859, and calling for an opinion as to the sufficiency of the means proposed by the Board for checking the practice of *Koomaree* cultivation. I would have replied sooner, but have just received an interesting letter from Capt. W. C. Anderson, Supt. Rev. Survey, S. Mahratta country, an Ext. from which, along with Mr Grant's description of the Punam cultivation in Malabar, are forwarded as enclosures to this communication.

'2. In addition to climatic considerations, the chief evils of this rude system of culture are the destruction of valuable timber, at present urgently required for ship-building and railways, and the rendering of land unfit for coffee (see Mr Cannan's letter, p. 129) cultivation. Where trees do not attain a great size, laterite being near the surface, or where the timber cannot be removed to a road or river from physical obstructions, or where there is extensive bamboo jungle, there is not the same objection to this cultivation; the clearing of bamboos is useful, and the *Koomaree* yields a supply of millet grain to the hill tribes.

'3. In the course of my tours I have constantly an eye to the extent of *Komaree* cultivation, and it is a matter of satisfaction to me to find that owing to the practice being disallowed, it has ceased in Mysore, has also greatly diminished in the Southern Mahratta country, and is rapidly decreasing in Canara. The system is objectionable for the reasons above given, and I think every effort should be made to do away with it as far as possible, although motives of policy may perhaps require that this consummation be gradually brought about. This I would leave in the hands of the collectors, with the proviso that no virgin forest or forest of old standing be broken up, but that *Koomaree* be henceforth confined to land which has been within twelve years devoted to that purpose.

'4. *South Canara—Bekal.*—In Bekal táluk there is not *now* any valuable timber. *Koomaree* cultivation has always prevailed there to a great extent; and from its adjoining Malabar, where *Koomaree* is unlimited, it would be difficult to restrict it more than is suggested by the collector. The prohibition not to cut within nine miles of the coast and three of the banks of a river is wise, but there are exceptional tracts; and the granting of these should be left to the discretion of the collector. I may observe that it is more important to reserve on the banks of a river than on the sea shore, where trees do not thrive, and are chiefly valuable for firewood.

'5. *Sulia.*—In Sulia there is much young teak and blackwood coming on, under the supervision of Mr Thompson, forest overseer, who resides at Putúr, and any application for *Koomaree* land in the neighbourhood might be submitted to him for previous report.

'6. *North Canara.*—In North Canara (Supah and Yellapur), where there is much most valuable timber, and the conservancy of which is financially profitable, I would be more careful. I would disallow all *Koomaree* without previous sanction. The sub-collectors at Sirce and Honore, if not able personally to examine the spot, could refer the question to Mr Müller, assistant conservator at Shadshegur, or to the forest overseer at Hallál: permission being granted in each case by the European revenue authorities. Great supplies of timber have been made to public departments from these two táluks, and the railway pressure is now heavy upon them. We cannot afford to give up any of the fine forests for *Koomaree.* There are here and there pieces of inferior jungle where *Koomaree* might probably be allowed without much mischief, but the spot should always be first inspected.

'7. *Permanent Cultivation preferable.*—With reference to par. 4 of the Pro. of Government under reply, there cannot be a doubt that it would be better if cultivation was confined to lands *permanently cleared*, and there is every reason to believe that the millets would be produced abundantly in the rich soil of the ghats, particularly if the plots were enriched by cattle and leaf manure. Perhaps some of the land now used for *Koomaree* culture would not bear a series of millet crops; but in all probability a judicious rotation would obviate the necessity of change of a locality. When the cultivation is confined to one kind of cereal, the land is impoverished, and nothing would answer so well above ghat, after cereals, as potatoes.

'8. *Result in Mysore.*—It was partly at my suggestion, in 1846, that the *Koomaree* culture was prohibited in Mysore, and the superintendents of Coorg, Nagar, and Astagram, under the Commissioner, have all assured me

that the system works well; and I may remark that the same amount of timber would not have been available for railway purposes, had it not been for this precaution.

'9. *Result in Belgam.*—The result of the rules in Belgam (noted at foot of the Pros. of Government, p. 136), will be found clearly given in Captain Anderson's letter, and appears to be very satisfactory.

'10. *Sanitary considerations.*—In regard to the result of *Koomaree* cultivation, in a sanitary point of view, I can affirm, from personal observation, and consultation with my professional brethren, that "permanent clearings are of unmixed advantage;" the dense thorny scrub, which succeeds a deserted *Koomaree,* is decidedly more injurious to health than lofty forests open below, and harbours destructive animals to a greater extent.

'11. *Punam of Malabar.*—The enclosure B. of Mr Grant shows that the Punam culture of Malabar is identical with the *Koomaree* of Canara; the soil, however, of that district is generally richer, and the results more profitable. The lands of Malabar being private property, I have never interfered. I may refer to Mr Beaumont's letter showing the effect of excessive *Koomaree* on the operations of the iron company; and I may add, that I hope, with Mr Grant, that the enhanced price of timber will lead the Jenmakars to stop Punam cultivation in many jungles.

'12. *Punakad of Salem.*—This is an erratic system of rude cultivation, carried on by the Malaiáils, a hill tribe inhabiting the Shevari and Chittéri Hills of Salem collectorate. Mr Fane, C.S., lately directed the attention of the Revenue Board to the injurious effect of this upon the future prospects of coffee planting.

'13. *Value of a Koomaree.*—In conversing with different revenue officers I have heard many opinions as to the profit realised by *Koomaree* cultivation. In a minute by Lord Harris, late Governor of Madras, dated 9th March 1857, in E.M.C., No. 235, Rev. Dep., par. 171, it was computed, on the authority of Mr J. D. Robinson, at Rs. 3 per acre, which seems to be rather low. I accordingly in-

structed Mr Müller to ascertain the actual gains as nearly as possible. He reports as follows:—

"I beg to submit a statement of what I ascertained from the *Koomaree* people on the spot:—

EXPENDITURE.

	Rs.	a.	p.
Assessment per 1½ acre, ...	1	8	0
Two men cutting for ten days, ...	3	0	0
Ragi seed, nine seers, ...	0	4	0
Clearing grass for one month, one man, ...	4	0	0
Watching three months, at Rs. 2 per mensem,	6	0	0
Gathering crop, ...	4	0	0
Rs.	18	12	0

RECEIPTS.

Ragi, 28 mudas at R. 1, ...	28	0	0
Profit, ... Rs.	9	4	0"

But as the *Koomaree* cultivators, who seldom break ground singly, employ their wives and children for all except felling, which they do themselves, the actual expenditure is reduced to the assessment, and that, in secluded valleys, is very often evaded. It is generally believed that one-half of the profit goes to the coast saukár, who gives an advance. The *Koomaree* cultivators live in wretched temporary huts, and make a very poor livelihood, offering a great contrast to the substantial homestead of the Canara ryot, who is generally well housed, and lives in considerable comfort.

'The system of the hill cultivators is nearly the same in different countries. The Irulars and Kurumbars on the Nilgiris, the Maláiális on the Shevarais, the Karens in Burmah, the Punam cultivators in Malabar, the *Koomaree* Mahrattas in Canara, all endeavour to obtain a precarious subsistence by scattering grain after burning the jungle, and thus avoid the toil of careful cultivation.

'In a thinly peopled country like Burmah, there is little objection; but in the limited plateau of Yerkád, where the best land is almost all taken up for coffee plantations or fruit-gardens, and in the balaghat táluks

of North Canara, where the remaining timber is much enhanced in value, and not more than sufficient for present demands, there are strong objections to this wasteful and barbarous system. I think that in Government forests, before clearances are made, permission should first be obtained from the revenue authorities in communication with this department, the locality and extent of the clearance being defined.'

In the final order issued by the Government, addressed to Dr Cleghorn under date of 23d May 1860, it is stated: 'It has been already noticed that in Mysore the practice of *Koomaree* cutting has been entirely abolished; and that in the jungle districts of Bombay it has been so very nearly. The Government now prohibit *Sarkar*, *Koomaree*, or *Koomaree* cultivation in Government forests without previous permission. This permission should be given sparingly, and never for spots in the timber forests.'

And in the Report for 1860 of Dr Cleghorn, as Conservator of Forests, it is stated in regard to this order:— 'The Government have issued definite orders on the future treatment of *Koomaree* cultivation in Canara, which is now prohibited except in cases where the land has been so cultivated within the last twelve years. It is understood that, under no circumstances, are valuable forests to be so treated. It has been shown that the system is injurious to the welfare of the wandering tribes by whom it is practised; for, although *Koomaree* is itself profitable, the growers are not the gainers, the Soucars on the coast enjoying the larger share of the profits. When *Koomaree* does not interfere with the growth of valuable timber, as in the táluk of Bekal (where it is exhausted) the Government has exercised forbearance, and it has been allowed to continue for the present.'

In the Presidency of Bombay the designation *Koomaree* takes the form *Koomri*. The Conservator of Forests in that Province, in one of his reports, apparently that of

1860-61, reports a great devastation in the Bedee Talooka, which had been occasioned by this practice of *Koomri*, and mention was subsequently made of *dullee* cultivation, which I conjecture to be the destruction of forests for permanent agriculture. It was subsequently recommended that no *Koomri* or *dullee* cultivation should be made either on hill or on other land without express permission from the collector of the district; it was again enjoined that existing orders relating to *dullee* or *Koomri* cultivation should be scrupulously attended to, and that the village authorities should be held responsible for this being done; and a hope that this would secure the forests from that destructive system was expressed by the Government.

This was done in 1864. In the course of the same year the Secretary of State, in a dispatch to the Governor of Bombay, in Council, brought under their atttention a letter which had been addressed to him by an officer in the Bengal army, alleging that the prohibition of *Koomaree* had the effect of producing fever. An enquiry was instituted by the Government at Bombay, the result of which satisfied the Government, both at home and in Bombay, that such was not the case.

Up to a comparatively late time this subject is adverted to in the reports of the Indian Forest Administration, and special reports on the subject are not awanting; but it is chiefly in those of an earlier date that I find such discussions of it, as I consider it expedient to cite.

In 1864 the effects of the practice on the health of the inhabitants of districts in which it prevailed, and the effects of stopping the practice upon the sanitary condition of different districts, commanded the attention of many officials in different parts. The opinions advanced were very conflicting, so conflicting that, to cite many of those which I have before me, would do more to confuse than to enlighten a student of Forest Science, who was not prepared to investigate the matter thoroughly. The facts adduced seem to me to indicate that the injurious

effects attributed to it, and to the restriction of it, were attributable only indirectly to the mode of operation, and were attributable mainly to the conditions under which it was practised or abandoned, in other words, to circumstances, determined by the state of the ground, as to access of humidity or the reverse.

CHAPTER III.

CONSIDERATION OF THE MERITS AND DEMERITS OF "SARTAGE" AS STILL PRACTISED IN FRANCE.

THE different designations which have been cited [ante page 56], as given to the practice in Germany, seem to indicate that it is a practice known to the people of some rural districts, as well as to the students of *Forst-Wissenschaft* or Forest Science, in that country.

In Switzerland also it is not unknown. Writing in 1832 of something similiar in Scotland, Sir Thomas Dick Lauder says:—

'We have seen this tendency to extirpation of forests in action in the Alpine forests, where large patches are burned down by the inhabitants, as heath would be on a hillside in Scotland, merely to increase the herbage and the value of the pasturage of the places where the trees grow. Uncouth black spots are thus frequently created in the middle of the dark green forests of the Swiss mountains, and the scenes of gloomy destruction which these exhibit when visited, with the huge trees standing half consumed, and stretching out their charred branches against the snowy peaks, and the clear blue sky, beggars description.'

And in France it is a practice recognised both in Forest Science and in Forest management. I have cited a statement of M. Parade, one of the founders of the French School of Forestry at Nancy, to the effect of its being a practice of very great antiquity; but what was apparently practised formerly extensively in France is now adopted there only in special circumstances.

In France it is found that the oak, and especially a hardy species or variety of the oak known in France as

the *rouvre*, of all forest trees sustains best the treatment of *Sartage*. In the Ardennes, the coppice woods, which are so treated, which are situated generally on a slope, and growing on a soil composed largely of slate schist, are composed almost exclusively of the *rouvre* oak, which, in these circumstances, yields excellent firewood and charcoal, yields very good workable wood in such trees as are reserved for mature growth, and, above all, produces bark of the first quality.

In connection with this last-mentioned circumstance, it may be stated that the quality of bark is in general good in proportion as the thickness of the liber or inner bark is more considerable compared to the cortical layers and the epiderm, in botanical phrase, in proportion as the *endophlœum* is thick in proportion to the *mesophlœum* and the *epiphlœum*, for the tannin is deposited chiefly in the *endophlœum*, inner bark, or liber. Now this portion of the bark is developed more largely in proportion as the process of vegetation is rapid, and as the wood is young. These two circumstances being combined in the coppice wood subjected to *Sartage*, it is reasonable to conclude that the bark obtained from such woods will be of superior quality; and thus can we account for the fact observed.

To such an extent is this fact the case that the bark and the cereals constitute the products which are considered the most important of those of the coppice woods thus treated. And it is the interest of the proprietor to have those woods cut down constantly after from 15 to 25 years' growth.

To prepare for the *Sartage*, the soil is stript bare—stript to the surface of herbage and turf; the wood having been barked while the spring sap was weak, and the wood having been carried off in the usual way, all chips, twigs, refuse, and *débris* are spread over the ground. The quantity thus spread is considerable, as in woods subjected to *Sartage* they do not make faggots, but cord only the wood exceeding somewhere about twenty-five millimetres, or one inch in diameter, and that whether it be designed for use as fire-

wood, or for manufacture into charcoal. On a calm day this is set on fire, and, the flames spreading, soon reduce the wood spread over the ground to ashes, precautions being taken against the spread of the conflagration beyond the limits prescribed. In France, in general, this takes place not later than the beginning of July. In the Odenwald, in the Grand-Duchy of Hesse-Darmstadt, the latest day allowed for the operation is the 10th of June. In the Ardennes, on the other hand, it is carried out in August and September. From these arrangements it follows that all the shoots of the first year are destoyed. This is an evil; and it may be that this second arrest of the vegetation of the stumps affects their vitality and durability. On the other hand, the check thus given to vegetation is followed with this effect: in the next spring, and sometimes also in the spring following that, there are produced only shoots in the best conditions for resisting the cold of winter; and this in a climate so rude is, perhaps, a circumstance essential to their growth.

When the time for sowing the cereals has arrived, these are scattered over the ground, and covered by a light application of the hoe. If the *Sartage* have been effected early, buck-wheat may be cultivated in the first year, and rye in the year following; but if, on the contrary, the season has been pretty far advanced, the grower sometimes must be satisfied with a single crop of rye.

This mode of burning the small wood and *débris* is known as *Sartage à feu courant*. The ashes yielded by it add to the fertility of the soil by the salts which they contain, and by the property which these possess of attracting humidity from the atmosphere, and of retaining it in such a way as to yield it only slowly to the plants. It is said, moreover, to be undeniable that they constitute a powerful stimulant for vegetation, whatever that may mean. It may then easily be imagined that after *Sartage* both the cereals and the shoots will grow with great vigour. If sometimes it happens that the effects of the fire are injurious to the reproduction of wood, by

destroying seedlings and young plants, and by partially carbonising the surface of stumps; on the other hand, they, by the high temperature imparted to the soil, induce an abundant and remarkably vigorous growth of shoots; and another advantage of *Sartage* is that the cereals afford shelter and protection to the shoots when young.

It is against cold winds, much more than against the sun's heat, that it is of importance to have the shoots protected during the first two years of their growth.

In the Ardennes it was customary formerly to leave standing around each felled and cleared portion of the forest a *cordon* of timber trees, which supplied to them protection and defence, and offered advantages superior to those following the *Sartage à feu courant*, inasmuch as this scarcely admits of the reservation of trees for a prolonged growth in the cleared part, and such are desirable for cover and for shade, even when they may not be required for the production of seed to be self-sown in the ground. But little by little these cordons have been used up, they have not been replaced, and since they have disappeared it has been remarked, principally on the *plateaux*, that the reproduction of coppice woods has become more and more precarious. To this destruction of these sheltering *cordons*, joined to the abuse of pasturing, is attributed without hesitation the great degradation and falling off of certain forests in that district. And for the lack of that shelter the culture of cereals in connection with *Sartage* is supposed to supply a remedy more or less efficient.

Besides the *Sartage à feu courant* there is another mode of sartage called *Sartage à feu couvert*, to which recourse is had when the ground is covered thickly with herbage, creeping plants, and turf. The soil is pared by means of a hoe, and of the vegetable product there are formed a number of little heaps to which fire is applied, and the ashes are scattered over the whole area of the ground which has been cleared, after which the procedure is the same as has been detailed.

This mode of *Sartage* is not so advantageous as the other. It is followed by a less abundant and a less vigorous growth of wood, which is attributable in part to too much earth being in some places taken up with the turf, and this earth, burned and calcined, spread over the ground with the ashes, is not adapted to promote vegetation; and in part to the roots being sometimes cut or injured, or too much exposed, and to the soil not being equally treated over the whole of its surface.

Another disadvantage attaching to *Sartage à feu couvert* is, if the turf have not been completely reduced to ashes, a small pellet of half-burned turf falling on a stump, in the scattering of the ashes, may suffice to cause that stump to perish.

This mode of *Sartage* is also more hurtful than the other, on steep acclivities, because it makes the earth mobile to a greater depth, and exposes it more to crumble away. But it gives greater facility for preserving trees, within the cleared area, for prolonged growth, with some chance of success, as the fire can, at will, be kept at a distance from these, which cannot be done with the *Sartage à feu courant*, unless recourse be had to special precautions.

Whatever be the mode of *Sartage* employed, it is desirable (say MM. Lorentz and Parade, from whose *Cours Elémentaire, de Culture des Bois créé à l'école Forestiere de Nancy*, these statements have been derived) to follow up some *Sartages* with plantings or sowings, as a means of ensuring the perpetuity of good growths; and more especially is it so with the oak. But planting and sowing seem to be less necessary in woods treated thus than in other coppice woods, because of the facility with which the shoots in woods so treated send out roots of their own, and form thus new supports for themselves, independent of the mother stump This fact, which is unquestionable, is attributable without doubt to the earth being, by the working of the soil, brought up upon the stump to the

level of where it was cut across. Still it always happens that in every clearing by *Sartage* there are void places which it would be well to fill artificially.

In the Ardennes, immediately after the reaping of the cereals, brooms and other brushwoods sprout up in great abundance, especially where the coppice has been subjected to *Sartage à feu courant.* These bushes often stifle the seedlings. But by planting these when from 18 inches to 3 feet in height, and previously prepared in a nursery, and by rooting out from the first year's growth the bushes which may spring up around them, the success of the operation may be rendered almost certain.

The presence of these bushes in the clearings is at the same time advantageous to the shoots in their tender age, inasmuch as they protect them against the inclemencies of the weather; and these small bushes supply products which may be subjected to regular exploitation some few years after the clearing of the wood, there being a demand for them, more especially as firewood for ovens. It connection with this it may be remarked that there is a danger of the growth of these bushes being allowed to go on too long, with a view to deriving from them the more profit, in which case the shoots of hard wood, especially those of the oak, loose too soon their lower branches, forming no body in these from deficiency of light; and they are often liable to languish or to be crushed by the snow when the support supplied by the brushwood is withdrawn.

To confine the fire within the area of the clearing, the ground around this is broken with a pickaxe to a certain extent immediately before the fire is applied, and men are stationed all around the enclosed space to meet and subdue the fire, if by any chance it extend to the parts beyond. In some localities in Germany when the area is extensive, they take the additional precaution to subdivide it into a number of separate portions, one of which only is burned at a time. The separations are made by breaking up a

portion of the ground on each portion, or by putting as circumscribing divisions, the poles—the products of the fellings, which, forming a continuous pile, constitute a raised rampart against the spreading of the fire; and further, the circumference of the entire clearing is dug up to the extent of several yards.

CHAPTER IV.

CLIMATIC EFFECTS OF "SVEDJANDE," OR "SARTAGE," IN FINLAND.

By *Svedjande* and its consequences, including undesigned extensive fires in the forest occasioned by the spreading of the fire beyond the area contemplated and designed for cultivation, there is being carried out in Finland a process which, in the same, or in some other way, has extensively cleared Europe of forests, which at one time extended almost continuously from these lands to the extreme south, and from the Atlantic to the Transylvanian regions in the extreme east. From what has been stated, it appears that there are in Finland districts in which this *Svedjande* is now prohibited; others in which it is carried on under restrictions; and others in which it is tolerated and apparently freely practised. In this we have an epitome of what, on a larger scale, is seen in Europe at the present time: the sites of what were immense forests are now densely inhabited by an agricultural and industrial population, with only here and there vestiges of the ancient forest, of which the existing forests in Norway, Sweden, Finland, and Northern Russia are the remains of the northern selvage; in some regions, as in some of these northern parts, the work of destruction is still going on; in others this is impossible, because all the forests have been already destroyed; in others it is restricted by the imposition of legislative enactments, to secure the exploitation of the forests being carried on in accordance with the most advanced Forest Science of the day, securing a sustained production, and natural reproduction, of the forests, along with the amelioration of the condition in which they are or have been; and in some districts of

France, Spain, Italy, Austria, and Hungary, there are being carried on extensive sylvicultural operations designed to counteract evils which have been found to follow the destruction of forests which has already occurred.

Of the epitome of this, which we have in the present position of the practice of *Svedjande* in Finland, I avail myself to bring under consideration the general subject of the extent to which the destruction of extensive dense forests may be expedient in the interests of the inhabitants of the lands in which they exist.

It has been made subject of complaint, and it may be the case, that wherever man has gone to settle and replenish the earth he has found it a wilderness, a dense jungle of forests, and he has made it a desert, going forth then to seek fresh fields and pastures new, again to repeat the work of destruction. I repeat it may be so; but, on the other hand, it is the case that we have no indication that it is the will of the Creator of these forests that the earth should be anywhere continuously and always covered with forests. It is a popular doctrine that on an exposed rock there alights perchance the spore of some lichen, which, finding there conditions favourable to its germination, forthwith grows, and reproduces spores, and dies; that in process of time there alights on its decayed remains the spore of a moss or fern, or other cryptogam, which finds now what it would not have found before, and which others of its kind alighting there aforetime found not, a soil appropriate to its growth; and forthwith it germinates and grows. And again, long after this, there alights on the decayed remains of these cryptogams the seed of some flowering grass, or herb, or tree—the follower, it may be, of many which had fallen there and had been blown away, or had been washed away, or had perished; but this finding now what these could not find erstwhile, conditions favourable to its vegetation, it germinates, and begins a new departure in the clothing of the rock with

verdure of grass, and herb, and bush, and forest trees. But he would be a rash man who would say that was the final end of all the preparation through which the soil had gone. As the lichen, and the moss, and the fern, and the grass and herbage, each in turn and in its measure, proved a befitting preparation for the arborescent vegetation which followed, so may the growth of this be a preparation of soil for the vegetation of fruit trees and herbage supplying appropriate food for man, and for beast of like organisation. Such seems to have been the process by which the earth as a whole became a fit residence for these; and everywhere we still see processes of creation being repeated, with variations accommodating them to the varying circumstances.

The production of the primæval forests may have followed a struggle for life in which the seeds of herbage of contemporary production, not meeting conditions so favourable to their growth and reproduction as did the trees, had to succumb for a time. It happens in many cases now where trees are destroyed by tempests or by fire, accidental or designed, that trees of the same kind, or it may happen, and often does so, trees of a different kind, forthwith are produced on the spot. It seems reasonable to suppose that the latter are the progeny of a race suppressed in a previous struggle, which now have met with conditions more favourable to their vegetation than did their progenitors, and more favourable to their vegetation than are the altered conditions to the vegetation of the kind of trees which had triumphed in the former struggle. But there are also places in which the accidental destruction of trees has been followed by the production on their site of grass and herbage, the progeny, it may be, of those which succumbed in the first struggle, but which now, in like manner to the trees referred to, have germinated in circumstances more favourable to their vegetation than were those in which their progenitors perished, and more favourable to their vegetation than to that of the seeds of the trees which have been destroyed; and now they

flourish on soil enriched with the dust of the conquerors in the former struggle, which has proved more favourable to their growth than to the reproduction of the progeny of those trees who had been for ages the holders of the soil. And what thus seems to frequently occur without the intervention of man, may be what is promoted by man's industry and enterprise in his migrations from place to place, in quest of a home, seeking rest and finding none.*

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* In a volume entitled *Hydrology of South Africa* † I have had occasion to cite the following statement :—

'Almost everywhere,' says Schleiden, Professor of Botany in the University of Jena, 'in the great characters in which nature writes her chronicles, in fossilized woods, layers of peat, and the like, or even in the little notes of men, for instance in the records of the Old Testament, occur proof, or at least indications, that these countries which are now treeless and arid deserts, part of Egypt, Syria, Persia, and so forth, were formerly thickly wooded, traversed by streams now dried up or shrunk within narrow bounds; while now the burning glow of the sun, and particularly the want of water, allow but a sparse population. In contrast must not a jovial toper laugh indeed, who looks from Johannisberg out over the Rhine country, and drinks a health in Rüdesheimer to the noblest of the German rivers, if he recall the statement of Tacitus, that not even a cherry, much less a grape, would ripen on the Rhine! And if we ask the cause of this mighty change, we are directed to the disappearance of the forests. With the careless destruction of the growth of trees, man interferes to alter greatly the natural conditions of the country. We can indeed now raise one of the finest vines upon the Rhine, where two thousand years ago no cherry ripened; but, on the other hand, those lands where the dense population of the Jews was nourished by a fruitful culture are, in the present day, half deserts. The cultivation of clover, requiring a moist atmosphere, has passed from Greece to Italy, from thence to Southern Germany, and already is beginning to fly from the continually drier summers there to be confined to the moister north. Rivers which formerly scattered their blessings with equal fulness throughout the whole year, now leave the dry and thirsty bed to split and gape in summer, while in spring they suddenly pour out the masses of snow, accumulated in winter, over the dwelling-places of affrighted men. If the continued clearing and destruction of forests is at first followed by greater warmth, more southern climate, and more luxuriant thriving of the more delicate plants, yet it draws close behind this desirable condition another which restrains the habitability of a region within as narrow, and perhaps even narrower, limits than before. In Egypt no Pythagoras need now forbid his scholars to live upon the beans; long has that land been incapable of producing them. The wine of Mendes and Mareotis, which inspired the guests of Cleopatra—which was celebrated even by Horace—it grows no more. No assassin now finds the holy pine-grove of Poseidon, in which to hide and lie in ambush for the singers hastening to the feast. The pine has long

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† *Hydrology of South Africa;* or details of the former hydrographic condition of the Cape of Good Hope, and of causes of its present aridity, with suggestions of appropriate remedies for this aridity. In which the desiccation of South Africa, from pre-Adamic times to the present day, is traced by indications supplied by geological formations, by the physical geography or general contour of the country, and by arborescent productions in the interior, with results confirmatory of the opinion that the appropriate remedies are irrigation, arboriculture, and an improved forest economy; or the erection of dams to prevent the escape of a portion of the rainfall to the sea,—the abandonment or restriction of the burning of the herbage and bush in connection with pastoral and agricultural operations,—the conservation and extension of existing forests,—and the adoption of measures similar to the *réboisement* and *gazonnement* carried out in France, with a view to prevent the formation of torrents and the destruction of property occasioned by them. London: Henry S. King & Co. 1875.

With the theological views generally accepted throughout Christendom we seem warranted to consider the creation of man, with the foreknowledge of all that man would do in seeking to create new homes, when the homes of childhood became too strait for him, as a part of the provision made for the earth becoming what the Creator designed it to be. And thus may we be led to consider these primæval forests as one of the means designed and employed to prepare the soil for man's use; occupying it till required, and all the while slowly but surely preparing it for this as an important, if not also its final purpose; and which, after having subserved this end, should gradually give way, and in a great measure disappear, before man's industry and energy.

On exposed rocks in Finland, as elsewhere, we still see, as I have stated, the lichen, the moss, the fern, the flower-

since retired from the invading desert climate to the heights of the Arcadian Mountains. Where are the pastures now, where are the fields around the holy citadel of Dardanus, which at the foot of the richly-watered Ida supported three thousand mares? Who can talk now of the "Xanthus" with its hurrying waters? Who would understand now the "Argos feeder of horses?"'

And Fries, of Lund, tells: 'A broad band of waste land follows gradually in the steps of cultivation. If it expands, its centre and cradle dies, and on the outer borders only do we find green shoots. But it is not impossible, it is only difficult, for man, without renouncing the advantage of culture itself, one day to make reparation for the injury which he has inflicted, he is appointed lord of creation. True is it that thorns and thistles, ill-favoured and poisonous plants, well named by botanists, "rubbish plants," mark the track which man has proudly traversed through the earth. Before him lay original nature in her wild and sublime beauty. Behind him he leaves the desert, a deformed and ruined land; for childish desire of destruction, or thoughtless squandering of vegetable treasures, have destroyed the character of nature; and man himself flies terrified from the arena of his actions, leaving the impoverished earth to barbarous races or animals, so long as yet another spot in virgin beauty smiles before him. Here again, in selfish pursuit of profit, consciously or unconsciously, he begins anew the work of destruction. Thus did cultivation, driven out, leave the East, and the deserts perhaps previously robbed of their coverings; like the wild hordes of old over beautiful Greece, thus rolls this conquest with fearful rapidity from east to west through America, and the planter often now leaves the already exhausted land, the eastern climate become infertile through the demolition of the forests, to introduce a similar revolution into the far west. But we see, too, that the nobler races, or truly cultivated men, even now raise their warning voices, put their small hand to the mighty work of restoring to nature her strength and fullness in a yet higher stage than that of wild nature; one dependent on the law of purpose given by man, arranged according to plans which are copied from the development of manhood itself. All this, indeed, remains at present but a powerlesss, and for the whole, an insignificantly small enterprise, but it preserves the faith in the vocation of man, and his power to fulfil it. In future times he will and must, when he rules, leads, and protects the whole, free nature from the tyrannous slavery to which he now abases her, and in which he can only keep her by restless giant struggles against the eternally resisting. We see in the gray cloudy distance of the future a realm of peace and beauty on the earth and in nature, but to reach it must man long study in the school of nature, and, *before all*, free himself from the bonds of that exclusive selfishness by which he is actuated.'

ing herbage, and the representatives of arborescent vegetation doing what their progenitors have done for the land upon a stupendous scale long, long ages before. And as these lichens, and mosses, and ferns, are representatives of their progenitors, which, having done their work, passed away, so may the existing forests of the present be considered representatives of *their* progenitors, and of like arborescent vegetation elsewhere, which, having served their generation according to the will of God, are passing away and disappearing under the hand of man.*

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* During the years 1863-1866 I held the appointment of Government Botanist at the Cape of Good Hope. The following letter, which I had occasion to address to an energetic, active, patriotic minister born in the colony, supplies an illustration of the point under consideration :—

'Wynberg, 13th January 1864.

'The Rev. W. STEGMANN, Adelaide.

'MY DEAR SIR,—When we met you were pleased to say that I would indeed confer a benefit on the colony if I could devise a means of stopping the spread of the rhenoster bosch, which now covers the country for hundreds of miles, extending over districts which, within the memory of man, were covered with rich grass. I have given attention to the subject while prosecuting the tour from which I have just returned, and I give you the result.

'I have found the prevalent opinion to be, that the bush (*Elytropappas rhinocerotis*) has been spread over the country by the removal of sheep from one district to another; and statements have been made to me which were apparently corroborative of this opinion. It may be the case that thus the plant has been introduced into districts where it was previously unknown, but I find it more easy to account in another way for its general diffusion when once introduced.

'The plant has a flower composed of a number of distinct florets, like the daisy, the thistle, the hawk-weed, and the dandelion. Like several such plants it has a *pappus*, or down, attached to each fruit. It is from this it gets part of its Latin name. It has the down in two rows, the inner long and more or less feathery, the outer very short, and arranged like a crown, or toothed circle; and the other portion of the name, derived from *eltyron*, an envelope, is given from this.

'In Europe it is seen how such a *pappus*, or down, subserves the wide dispersion of the thistle and the dandelion. The down forms a tuft surmounting the fruit, and seems to be placed there with a special view to its being wafted to a distance by the wind. By the wind it is blown from the flower-stalk, and by the same wind it is borne away. It is stopped, it may be, by a hedge; but it only rests for a second or two, and it is again off and away. It is caught again by some other thing in its course, and it rests again, but only for a time. It reaches the ground, but it alights amongst grass, and it is soon again upon the wing. Follow it! follow it! it may lead you a long chase, but it must stop at last. At length it reaches uncovered soil. It falls gently as a parachute and it grapples firmly the ground. But the wind seems loth to cease its funning. The wind blows at it, and blows at it still, but it holds fast, It is turned round, and round, and round again; but no, it will not quit its hold; but neither will the wind cease its efforts to get it dragged away from its earthly rest, and round, and round, and round, but apparently in lessening circles, it turns, refusing to go. At length its struggles cease: but look at it, examine it closely, and you will learn why. These very gyrations have been working the fruit down, down, deep into the ground, and the wind now may, if it will, twist off the tuft of down, and boast of it as a love token or a trophy; but the seed is safely lodged in the soil, far, far, oh how far, from the parent plant.

'I speak of what may be seen at home on any summer's day. The same thing may be seen here occasionally with the seed of the *Senecio*, the ragwort, or groundsel; and so it is, I presume, with the seed of the rhinoster bush, which seems to me to be

From what I know of the functions discharged by forests in the terrestrial economy, and from what I know of the history of many, I consider it extremely probable that, as a mantle covering extensive regions of the earth, forests are but a temporary provision for existing temporary

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steadily advancing eastwards, threatening to conquer for itself all the grassy hills and dales and extensive vales of the Eastern Province and British Kaffraria, being borne onward, I presume, by the winds prevailing at the season of its maturity.

'Were the ground covered with verdure we should have little to fear; but of this it is often for a length of time devoid, in consequence of long-continued drought. In some districts the ravages of the locust occasionally remove what would have protected the soil; and in the same or other districts, by the short-sighted policy of burning the *veldt*, the ground has been specially prepared for the seed thus borne on the wings of the wind.

'To every practical man desirous of checking the spread of the rhenoster bosch, I would say: Stop, if you can, the desiccation or drying-up of the climate by the burning of the veldt; do what you can to restore the humidity of former days, by the erection of dams and the planting of trees; and keep all arable land under constant cultivation; and that for the following reason: There is going on everywhere what Darwin has described as the struggle for life. Something similar may be seen going on in different districts of the colony, and the extensive diffusion of the rhenoster bosch is one result of this.

'The drought and the burning of the bush, besides preparing the soil for the reception of the seed, have removed many plants which formerly occupied the soil, and the invader has made an easy conquest of the land. The aridity of the soil gives to this invader a great advantage over the down-trodden descendants of the previous occupants; but by cultivation you help for a time a plant less adapted to the soil than the invader, and thus that plant is allowed to arrive at maturity.

'The culture necessary for the perfecting of this crop, and the partial eradication of the invader, may allow the descendants of former occupants to regain something like their former luxuriance, and the culture may render the soil for a time somewhat less favourable to the growth of the bush; but drop the culture, and you may find, as I have witnessed, the bush again invading the land within less than twelve months after the reaping of the crop; and therefore it is that I advise constant cultivation.

'I have said nothing on the question whether the spread of the rhinoster bosch is a blessing or a curse. I have only taken up the problem which you gave me. The whole plant is bitter and resinous, and the tops of the branches are not only given in powder to children affected with diarrhœa, and, infused in wine and brandy, to be used as a tonic in dyspepsia and other complaints, but I have been told they are eaten by sheep and by cattle. Still I consider the spread of the bush an evil. I question whether the bush and the plants associated with it supply food for flocks and herds equal to the grasses and herbs associated with them. In every case I consider the pastoral an inferior state of society to the agricultural, and whatever retards agriculture I consider an evil. One of the natural consequences of the physical, intellectual, and moral elevation of a people is, that the wilderness they inhabit shall rejoice and blossom as a rose.

'The heaven, even the heavens are the Lord's, but the earth has He given to the children of men. But He has given it to them to be used. He has done with this as with every other gift, wealth and strength, physical, intellectual, and spiritual: Use it and it is yours, and the more you use it within certain limits the more will it improve; but let it lie waste and you will lose the benefit. So is it here. The more the ground is cultivated—if this be done in accordance with the laws of Him who made it,—the more fruitful does it become. Neglect it and it is otherwise. At the same time there is no waste. If man wil not till the ground for his own use, God will resume it, and raise that which it is best in all the circumstances of the case should then be grown.

'If man be dissatisfied, the remedy is in his own hands: let him by manual labour raise corn or some other crop ministering to the wants of man or beast, and plant trees on spots which he cannot thus cultivate, and he will reap the reward. But if he acts otherwise, and not only refrains from so doing, but burns the veldt as an improvident means of saving himself trouble, he may read his sin in his punishment.

'Such is my interpretation of what is seen in this act of providential government.

'Who can harden himself against God, and prosper?'—I have, &c.

requirements, and that they are destined to pass away, and to become, as other forests in other places have become, things of the past, as really so as the forests and jungles of old-world lycopods and calamites, and cycads and conifers, the remains of which constitute the coal measures of the present. And also, that the destruction of these existing forests, which I deplore, and fain would arrest in many districts, is not everywhere and always an unmixed evil.

Consider what Central Europe must have been, and what must have been the condition of its savage inhabitants, when it was covered by one far extending forest; look to it now, and consider the condition of its inhabitants, and say has the destruction of the vast Hircinian forest been an unmixed evil? As is the case with Europe on a vast scale, such on a small scale is it with Finland. Here there is not a little land, now pasture land and cultivated fields, which, to make use of a common expression, has been recovered from the forest. Towns and cities and public buildings now stand where once grew trees of the forest; and within the forest bounds there are, besides these, extensive clearings produced accidentally by storms sweeping over the land, carrying all before them or compelling them to bow and break, and let them pass. These in many instances have been made subservient to the support of man and beast; and I presume that no one will say that in these cases the destruction of the forest was unmixed evil.

With regard to the immediate effects of *Svedjande*, it supplies, in the best possible condition, a soil such as the ground can yield. Of ground over which a forest fire has passed, Marsh writes:—

'Apart from the destruction of the trees and the laying bare of the soil, and consequently the free admission of sun, rain, and air, to the ground, the fire of itself exerts an important influence on its texture and condition. It cracks and even sometimes pulverises the rocks and stones on or near the surface; it consumes a portion of the half-

decayed vegetable mould which seemed to hold its mineral particles together, and to retain the water of precipitation, and thus it loosens, pulverises, and dries the earth; it destroys reptiles, insects, and worms, with their eggs, and the seeds of trees and of smaller plants; it supplies in the ashes which it deposits on the surface important elements for the growth of a new forest clothing, as well as of the usual objects of agriculture industry; and by the changes thus produced it fits the ground for the reception of a vegetation different in character from that which had spontaneously covered it. These new conditions help to explain the natural succession of forest crops, so generally observed in all woods cleared by fire and then abandoned.'

Thus may be accounted for the abundant crops, for the sake of which the practice is continued.

Should the ground not be retained permanently under agriculture, whether because it becomes exhausted of such constituents as are required for the crops desired, or from some other cause, it is, as is intimated in the statement quoted, likely to become covered again with a crop of self-sown trees, of the same kind as those destroyed, or of a kind of higher pecuniary value. This I have reported as having been seen by me on the banks of the Saima See, the firs were replaced either by a crop of fir or by a crop of birch. The fir or pine may be of more value for building purposes, but the birch supplies a better firewood; and for this there is, and there is likely to be for a long time to come, an ever-increasing demand in St. Petersburg, to which it can be sent from most places in Finland by water.

It may be asked next, should it happen in the case supposed, that the crop of trees destroyed be not replaced by another such crop, what will the proximate effect upon the climate be? To this, those whom I consider best qualified to judge, would say: Most probably one beneficial for agriculture.

In a volume entitled *Forests and Moisture; or Effects of Forests on Humidity of Soil,** I have stated facts which seem to show that the past and present distribution of forests over the earth has been affected by the distribution of moisture; that subsequently the forests affect considerably the distribution of the rainfall, both in time and space: that the extensive destruction of forests is followed by the rains becoming partial in their diffusion, falling now here, now there, and leaving extensive stretches of country unvisited, and irregular in their occurrence, falling often in thunder plumps instead of genial showers, and falling only once and again after prolonged intervals, instead of being diffused over several successive months in the course of the year; that thus have agriculture and horticulture in many lands been greatly injured; and that in some of these, and in other lands, enlightened statesmen are exerting themselves by the conservation, restoration, and extension of forests, to arrest, and, if possible, to avert, the calamity.

In another volume entitled *Réboisement in France; or, Records of the Replanting of the Alps, the Cevennes, and the Pyrenees with Trees, Herbage, and Bush, with a view to arresting and preventing the destructive consequences and effects of Torrents,*† I have given numerous details of the formation of torrents and the occurrence of extensively devastating inundations having followed the destruction of forests on mountain sides and mountain summits; and of these having ceased on the mountains having been replanted with trees or temporary substitutes.

According to the information communicated to me, there are extensive districts in Finland in which the forests are so extensive and continuous that there is no danger apparent of any such consequences following the continued practice of *Svedjande* in these; once and again I have stated that in some of these the accidental destruc-

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* Edinburgh: Oliver & Boyd. London: Simpkin, Marshall, & Co. 1877.
† London: Paul Kegan & Co. 1876.

tion of forest by the spreading of fire is tolerated, apparently complacently, by the proprietors; that in some of these it is not even restricted by the Government, though the practice is restricted in some districts, and prohibited in others; and here I may add, the practice, where it is tolerated, is approved by students of forest science, well fitted by their knowledge of facts and principles, and by their knowledge of the localities and circumstances and conditions of these to give an opinion entitled to respect.

It may be the case that there are extensive districts in Finland in which the destruction of forests has been carried to the extreme verge of safety; and some in which it may be the boundary line has been passed, but it is also the case there are extensive regions in which it is not so; and it is alleged that the effect of forests on the humidity of the soil and climate, for the sake of which, elsewhere, forests, such as have been recklessly destroyed, are now greatly desiderated, is not here required. Not only is it so, but as trees growing in close proximity to a dwelling-house are sometimes ordered to be felled because they make or keep the house too damp for the health or comfort of the inhabitants, so is the great abundance of forest existing in the districts referred to supposed to be injurious rather than otherwise to agricultural operations there.

From a statement in a work by P. Chr. Asbjoernsen, entitled *Om Skovene og om et Ordnet Skoverug i Norge* (p. 101), a work published in Christiana, referred to by Marsh, it appears that it has been remarked in Sweden that the spring in many districts in which the forests have been cleared away now comes a fortnight later than it did in the last century. I attribute this to protracted frost, consequent on diminished humidity of atmosphere. But, be this as it may, it is alleged in Finland that the desiccation consequent on the clearing of forest lands is favourable to agriculture in that country, where there is in spring an excess of humidity above what is desired, with no lack of this in summer and autumn. And I know of nothing upon

which might be based any objection to the truth of the allegation.

I may mention that there are numerous factors entering into the determination of the proportion of woodland to the meadow and arable ground in different localities which is most conducive to the production of the best crops, and many of these factors are subject to very great variation. We have general statements of the relative proportion of these existing in most of the countries of Europe. But this is not enough. The woodlands may happen to be mostly or all in one district, and the meadow and arable land in another. We have, in several successive reports issued by the Agricultural Department of the Government of the United States of America, statements of the relative proportion of them in different States of the Union; and along with these also reports of the relative proportions of them in the different counties or townships of these States. These statements promise to supply data of considerable importance in determining some one or more of the variable quantities entering as factors into the determination of the general question. But from the accomplishment of the determination of this we are still very far. In the absence of this we may gratefully accept as contributions towards the solution all general observations which have been made, and amongst these may be included those I have cited in regard to extensive partial clearings of the forests in many districts of Finland being favourable to agricultural operations there.

It is not without due consideration that the practice of *Svedjande* has been continued in Finland.

On 27th July 1865 a Commission was issued to three Commissioners named, to enquire into the state and condition, the extent and the capabilities of the Crown forests in the Grand Duchy, the management of these and the administration requisite for the development of their resources. These Commissioners gave attention to this

subject amongst others. They issued several successive reports in the course of the years during which they were occupied with their enquiries. That in which this matter was made the subject of report was one issued in 1872, under the title *Kommissionens för undersickning af hällandena inam Kronoskogavne i Finland slutliga yttrande och förslag i amnet.*

In this, amongst other subjects upon which they report, or to which they refer, is the climatal effect of woods and forests, in regard to which they say :—'The meteorological influence of woods and forests is a subject which ought to be seriously considered in a land such as Finland.

'We have the testimony of history that the climate of Central Europe has improved as agriculture has advanced and forests have been destroyed. At the same time not a few who have given attention to the subject have brought forward what they consider evidence of a contrary effect having been produced, and they allege that when agriculture is carried beyond certain limits this deteriorates the climate. To the determination of the point at issue it is necessary to ascertain whether the effects said to have been produced are all attributable to one and the same cause, or to several distinct causes in operation at the same time, or even at different times, in the same place, or even at different places.

'A climate may be affected injuriously or otherwise either by increased light and heat, or by increased cold and rain; and it is from the influence attributed to woods and forests that students of climatology have been led to take up and discuss the subject of conservation of forests.

'Some contend for the conservation of forests as a means of preventing an increase of light and heat, and they tell amongst other things how, in the Italian peninsula, as in Lombardy, even with its forests and its system of artificial irrigation, the flow of springs and streamlets has been diminished, and in some cases these have been dried up where woods have been destroyed and the brush-

wood cut down, and the climate has thus been affected injuriously.

'But were any one, reasoning from this, to condemn the felling of woods in Finland, and this should be stopped, it would be found that a great mistake had been made, seeing that from its northern position, from its being nearly surrounded by sea, and from its being studded with its thousand lakes, Finland has an insular and moist climate, and not a dry one, and therefore the moisture which woods are alleged to produce or retain is less necessary than in that case it would have been. And that the woods are not required to absorb or diminish the solar heat is proved, amongst other things, by the agriculture of the country, which, when the field is well sheltered by woods, seldom produces good crops or well-filled ears. While in Southern lands it is often recommended to the agriculturist to surround his fields with growing trees to give them shelter, here experience teaches the agriculturist on the contrary to remove the trees which are around the fields which are under cultivation.

'What is more especially required for the improvement of the climate of Finland is a reduction of the moisture which is in the atmosphere and the soil. And if it be so, there comes up in connection with this another matter, which in this light is seen to be of no small importance. So long as there is so much wood as there is, it would be exceedingly expensive to dry the land, and therefore, economically, it is impracticable to do so. From this it follows as a necessary consequence, that it could bring no climatal benefit to Finland to interdict the felling of forests where there is at present too much wood.

'This has been contradicted. It has been alleged that woods, while creating shade, prevent the radiation of heat from the earth, and thus prevent the occurrence of frost in a dry, clear summer night. And there is no necessity for any one to dispute the allegation. On the contrary, it may be admitted to be beyond a doubt that it is so; and that the coolness connected with the shade where the

locality is not completely dried may be more conducive to prevent frost through the operation of moisture in diminishing its severity, and it may thus benefit the husbandman.'

CHAPTER V.

DEVELOPMENT OF MODERN FOREST ECONOMY IN FINLAND.

THE tolerance in some districts of Finland of the apparently wasteful practice of *Svedjande* or *Sartage* is not incompatible with an endeavour to introduce the strictest economy into the management of forests in the same districts and in others, nor is there anything inconsistent in the endeavour to carry out simultaneously the two apparently conflicting methods of forest treatment.

In Nature—*Natura naturata*, to make use of a distinction drawn by Coleridge, not *Natura naturans*, of which poets speak—we find profusion in combination with the most astounding economy of material and of force, though the command of both seems to be infinite.

> 'Full many a gem of purest ray serene,
> The dark unfathom'd caves of ocean bear;
> Full many a flower is born to blush unseen,
> And waste its sweetness on the desert air.'

Yet we are told by Christ, 'Not a sparrow falls to the ground without your Father,' and 'The very hairs of your head are all numbered;' and the student of science, while measuring the waters of the sea, or computing the age of the earth, looks up to tell that it seems to him not one atom of matter has been destroyed, or the minutest measure of force been lost, since the world began. 'Consider the lilies of the field!' says Christ. There is not one of them but has been produced without waste, and finished with the perfection of beauty and economy in detail, though, flourishing to-day, to-morrow it may be thrown into the fire.

In accordance with this is the combination in question, and it is a combination which may be seen also in coun-

tries in which the forest economy is the most advanced, any difference in details being easily accounted for.

Thus in France we find *Sartage* practised in special circumstances, while the forests of the country are managed in accordance with the most advanced forest science of the day; nor is there considered to be anything incongruous in this. In Finland we find that a forest management, which is in accordance with the most advanced forest science of the day, is being generally practised in the Crown forests throughout the country, while, subject to the restrictions which have been mentioned, *Svedjande* is practised, preferred, and justified in dense, extensive forests. The conditions of the two countries are different. The improved forest economy of France dates from the issue of the celebrated Forest Ordinance of 1669, if not from a much earlier day. Compared with this, the improved forest economy of Finland is a thing of yesterday!

Finland, though erstwhile an independent country, was for a long time a province of Sweden, and it is now a province of Russia, possessing many privileges and well defined extensive powers of legislation and government.

It was on 17th September 1809 that Finland was annexed to the dominions of Russia as a Grand Duchy, with the enjoyment of these privileges and of government under its own laws issued in accordance with its constitution. All the later improvements in forest economy have been made since that time; and it is under Russia that the forest economy of Finland has attained to its present condition. This development has taken place in the course of the last five-and-twenty years.

Till 1809 Finland was connected with Sweden, and up to that time the history and development of the natural resources, and, to a very great extent, the laws of the two countries were the same. In regard to the former state of culture in the country, so far as forests are concerned, information upon which reliance may be placed may be found in Agardh's *Statseconomisk Statistic afra Sverige, 3d Delen, 1st Haftet.*

A considerable time elapsed before any important change was made. On the 15th May 1848 there were issued Imperial Instructions relative to the management of the Crown forests, along with regulations relative to surveys to be made; and in 1857 there were made new provisional arrangements for the management of these forests.

The honour of originating the improved forest administration has been assigned to Staatsrath C. W. Gylden, who reckoned in 1851 that more than half of the whole area of Finland, 5924·7 geographical square miles, was forest, divided thus :—

In Nylands Län, - - -	141·3
Abo, - - - - -	274·2
Tavastehus, - - - -	202·9
Wyborg, - - - -	408·3
St. Michaels, - - - -	239·7
Kuopio, - - - -	429·7
Wasa, - - - -	388·8
Uleaborg, - - - -	1488·8
	3573·7

From the work of Dr Ignatius we learn, that to secure a more economical and efficient management of the forests, certain arrangements were made, and published with authority on the 14th January 1851. Previous to this, the regulation of forest operations lay with the department in charge of the land surveying of the Grand Duchy. At the time stated it was found that the limited number of persons engaged in what may be called the forest service —seventeen in all—could do but little, and it was deemed necessary to introduce some new and different organisation for the management of the forests. With this in view, and with a view to the application to this of the general principles of forest science, modified as might be required by the condition of the country and its grand divisions, Baron von Berg, Oberforst-rath or Oberforst-councillor of Saxony, the country of Hartig and of Cotta,

was called in to give professional advice. He, after making a tour of the forest districts, submitted a plan for the management of the forests. This is the principal basis of the existing forest economy of Finland ; and some of its details were adopted in the organisation carried out for the subsequent administration and management of forests by the Government. Under date of 7th May 1859 there was issued at Helsingfors, in the name of the Emperor, a Government notice relative to the organisation of the forest establishment for the conservation, protection, and management of the Crown forests; and on the 13th of the same month there were issued Instructions for the practical management of these.

These two documents were afterwards issued from the printing office of the Imperial Synod at Helsingfors in 1860, in the form of a pamphlet, bearing the title *Naediga Statganden Augäende Wärden och foerwaltningen af Kronoskogavne i Finland ;* and in an appendix are given several forms to be followed in keeping and rendering the accounts of operations and of proceeds.

In accordance with the policy of the Government to maintain an absolute form of self-government in common affairs, with absolute autocratic government in national matters, great power of self-government in what related to local interests was assigned to Finland; and in accordance with the provisions for Home Rule, the Legislative Assemblies of the Grand Duchy entered at once on the discharge of the duties assigned to them. In 1863 and 1864 attention was given to the state of the forests, and the way in which they were being managed. On the 1st of August 1863 there was instituted a special organisation for the conservation, management, and exploitation of the Crown forests, which had previously and till that time been under the control of the Surveyors' officers; on the 27th July 1865 was issued the Commission previously spoken of, given to three Commissioners named, to enquire into the state and condition, the extent and the capabilities of the forests in the Grand Duchy, the management of

these, and the administration requisite for the development of their resources; and on 2d November 1865 were issued special instructions from the Economical Department of the Imperial Senate of Finland to the Commission which had thus been appointed to enquire into all matters relating to the Crown forests in Finland.

Of these Commissioners it was required that, having made themselves acquainted with the Imperial Forest Ordinance of the 9th September 1851, the Imperial notification relative to the forest establishment of 7th May 1859, and the Imperial instructions relative to the management of the Government forests and the land surveying regulations of the 15th May 1848, they should endeavour to obtain trustworthy information in regard to the Crown forests in Abo and Björneborgs, Tavastehus, Wasa, Uleäborg, and Kuopio läns (counties or districts); enquiring into the general condition of the forests which thus far had not been constituted Crown parks, and enquiring particularly (1) concerning the authority or ground upon which the population living in these forests had established themselves there, and were prosecuting agricultural operations, and to what extent and upon what conditions, more or less of that population might on that ground claim in whole or in part a continued enjoyment of the advantages which they then possessed.

(2) Which and what of the Crown lands, in view of their character, position, and climatal conditions, ought more especially to be reserved on account of the Crown.

(3) What disposition should be made of Crown forests which had not been constituted Crown parks, and all that related thereto in regard to

(*a*) Their fitness for Crown buildings and Crown crofts.

(*b*) Their fitness for being occupied for a time by private persons for agricultural purposes, and the terms on which this should be done, and to what extent and on what conditions the greater part of the Crown forests should either be let to private parties on a wood rent or a capitation tax, or be otherwise disposed of by the Crown.

(4) The expediency of preventing new settlements on unsurveyed forest land.

(5) The way in which the Government should act towards the Forest-Wardens, and how new forest products should be disposed of for the best advantage to the State, attention being specially given to the question how far it is expedient to permit in certain districts the burning of the woods to clear them away for agriculture, the cutting of wood for the preparation of tar, the collection of resin, or of stumps and roots for tar manufacture; and to the question of the expediency of maintaining the prescriptions which have been hitherto in force, and to that of the mode or conditions of sales of timber from the Crown forests.

The Commissioners were required to obtain on the spot for themselves the information so desired in regard to the various Crown lands which were under consideration, and they were authorised, as they proceeded with the work, to require from the authorities in the several läns, servants of the Crown, land surveyors, and forest officials, such information in their possession as might be required for the accomplishment of the object of the Commission; and they were authorised to obtain information from private persons on any point connected therewith.

The Commissioners were further required to give to the Imperial Senate a full and complete report of the result of their enquiries with the measures deemed appropriate for adoption in each locality, and an expression of their views on the same, each, when necessary, expressing his own, in regard to the general wish, and the extent to which this can be gratified in combination with due regard to the interests of the Crown, to the rights of the community, and to the subsequent development of the resources of the country.

On the 1st December 1866 the Commissioners made their report in regard to the Crown forests in the läns or counties of Tavastehus, Abo, and Björneborg, Wasa, and part of Uleäborg läns, reporting details of their tours of obser-

vation and of the observations they had made, with their comments on the same. On the corresponding day in the following year they made a similar report in regard to the Crown forests in the remaining part of Uleaborg and in Kuopio; and again, on the corresponding day in 1868, they made their report in regard to the Crown forests in Kemi, and on the 25th March 1869 they issued their final report, stating conclusions to which they had come, and submitting suggestions for the subsequent management of the work of the forest administration.

In their report this Commission, after commending the forest economy of Bavaria as well deserving of study by any who would see what might be done, and commending the forest science of France as not less suggestive, and referring to Switzerland as a country practically protesting against a stricter conservation of forests—there forests, according to report, being treated with great recklessness notwithstanding that the severity of the climate in the mountain districts, and many other things, including devastating torrents, seemed to manifest a greater necessity for well preserved woods than is the case in many other lands,—proceeded to call attention to the interest which had been taken in the question of forest economy in the adjacent country of Sweden, as being well deserving the consideration of statesmen and foresters in Finland.

The Commissioners traced the increased interest which was then being manifested in Sweden in the conservation and economical management of forests, whether held by the Crown or by private proprietors, to the consideration which had been given to the subject in the close of the last century and the commencement of the present, and to the forest regulations issued in 1805, which regulations were then still in force. They stated that nothing which had subsequently occurred previous to the Agricultural Fair of 1853 required special notice; but that then, through the progress of events, the subject was brought under discussion in connection with other questions raised

relative to agricultural development by the question, What measures should be adopted to arrest the destruction which has taken place in several localities of woods which are private property, which threatens to cut off the supply of wood in such localities, and to produce an injurious influence on the climate; and how far does it come within the legitimate duty of the State to watch over the conservation of the forests, and aid in the management of these in the provinces of the kingdom?

A Committee appointed at that meeting to take the whole subject into consideration submitted that a better knowledge of the value of woods, and of the treatment which should be given to them, should be secured by the establishment of Forest Schools; that, as a branch of social economy, there should be introduced an improved forest economy; that in the several läns, districts, or counties of the country, there should be organised a proper game and forest service, not only for the protection of the whole of the forests belonging to the Crown, but, by friendly co-operation, to help private proprietors of forests in the division and protection of their forest territory; that the destruction of growing trees should be considered a misdemeanour injurious, and punishable by fine; and that all burning of woods with a view to agriculture in moors and outlying territory should be prohibited, as the conversion of such woodland into arable land and meadows in connection with the clearing of tracts of woodland by private proprietors must, in its consequence, in a certain way diminish the future growth of wood.

The subject came under the consideration of Parliament, and the Senators who discussed the question in the Parliament of 1854 agreed generally with several of the views advanced, and considering it competent to the State to restrict the power of private proprietors in the disposal of their woods, on the ground that this was necessary to secure the reproduction of forests; they could not avoid seeing the injurious results which were following the bad

forest economy of the kingdom, and seeing that corresponding restrictions should be introduced into the management of the forests of the State, more especially in regard to the clearing of forest lands.

A Committee was appointed in the year following to prepare and submit a scheme embracing measures which should be adopted to meet omissions in the then existing law, and deficiencies in the powers of those who were entrusted with the administration of the forests. This Committee, as stated, on 28th June 1856, submitted such a scheme for the management of the forests. In this it was proposed, amongst other measures, that the destruction of saplings should be placed in the same category as depredations, and that proprietors of forests, in making use of the same for their own benefit, should be prevented from laying waste the same by mismanagement and destructive operations, and authoritatively prohibited from making use of these forests otherwise than in accordance with what it was natural and legitimate to do with them as forests.

The Finnish Commissioners state that at the date of their report, 25th March 1869, all that was thus designed had not been fully carried into effect, but that important legislative steps had been taken to secure that in certain districts a forest economy, founded on scientific principles, should be introduced into forests belonging to the Crown, and into woods attached to the residences of civil and military officials, and to ecclesiastical establishments; and that forests belonging to the community in other ways should be placed under the superintendence of the service established for the protection of game, in accordance with the Royal letter of 21st June 1859, and the Regulations of 14th April 1824. And they go on to state that several prescriptive rights had been by special arrangement recalled or modified; amongst others, *Svedjande* had put under restrictions only ground specially suited for agriculture was to be assigned for new settlements, and in the inspection or

allocation of Crown parks great regard should be had to the facilities for the transport or floating of timber which they might present.

In a subsequent report in 1872 the subject of *Svedjande* was discussed in a statement which has been cited in the close of the preceding chapter; and the subject of the forest administration, or body of officials entrusted with the direction of the management of the forests, was brought under consideration, with results which will afterwards be stated.

A third subject upon which they reported was that of the tenure of land, with forest rights, and claims to forest produce, based on usage, if not on documentary title.

In Finland, as elsewhere, difficulties arising out of, or otherwise connected with, the mode of land tenure with forest rights, obtained by prescription or by law, and by peculiar usages, were met with in the endeavours to improve the forest economy of the country in so far as this related to the forests belonging to the Government.

From information communicated to me by Dr A. G. Blomqvist, Director of the Forest Institute at Evois, I gather that the forests of Finland are in part private property, and in part the property of the Government—a part, but only a small part, belonging to communities. Of the private property, most are held in small farms by peasant or agricultural proprietors, and these are of two classes. The first, *Skatle Kemmon:* these have an absolute right to do with their forests as they please; the other, *Krono Kemmon:* these may fell for their own consumption and use, but not for sale. But they have the power to convert their tenure into freehold if they wish, and this most of them have done by an equivalent money payment. But this is in a great measure the result of arrangements which have been made within the last few years.

In their report the Commissioners say :—'In conclusion there comes up a question which is, in the estimation of the Commissioners, no less important. It relates to per-

mission being given to agriculturists to settle down within the boundaries of Crown forests where they may find land suitable for cultivation, and where an efficient supervision and protection of the forest is impracticable. Is it desirable that such permission, in such circumstances, should be given? To the Commissioners it appeared that in regard to this the history of legislation is very instructive, showing that the practice has done not a little to develope the *udal* rights of absolute possession, where, under a climate so severe, a people possessing only vassal rights would not and could not have been expected to prosecute and maintain the cultivation of the soil. While field labourers in most of the countries of Europe lying further to the south, wrought the land on account of the sovereign or of some feudal lord, the agriculturist in the north became the possessor of the field which he himself had created by bringing it under cultivation. Through the influence chiefly of the aristocracy, a change in the law was introduced. It had come to be considered that all land not under cultivation was considered Crown property, and under this assumption many sections were sowed by persons who had no right to the land, and who thereafter claimed the land as their own; and, in consequence of this, laws were adopted which confined and limited considerably the udalman's right of holding and disposing of property. But the force of circumstances coerced legislation on the subject, and secured legal recognition for *udal* rights, and for two centuries past the legislators have manifested a zeal altogether remarkable to secure the rights of possession to the settler dwelling upon Crown land, and to promote in every way possible, upon the most advantageous conditions, the acquisition of *udalman's* rights. And the Commissioners also considered that all who may go forth to settle in the Crown forests should be treated exceptionally, as the settlement there of a population not possessing an absolute right in the soil could not be otherwise than damaging to the wood, and detrimental to the land in every way. With such right they have a personal

interest in keeping all right, which otherwise they would not have.'

The Commissioners then proceed to report *seriatim* on the points already submitted to them for a report.

The report was made, accompanied by certain reservations made by one of the Commissioners, whose opinion was in favour of granting certain privileges to proprietors of mines and manufactories as required by the circumstances of the country. He was of opinion that the import tax was not sufficient to enable such to compete satisfactorily with foreign parties, and that protective duties were unjust in principle, taxing the consumer for the benefit of the manufacturer—the many for the benefit of the few. He argued that if such required firewood or charcoal, and had it not in forests belonging to them, they would be crippled in their operations, and so crippled that capitalists would not engage in such operations, and the country would suffer from the non-employment of the population, and the non-development of the resources of the people and of the land; and that wardens might be employed in such numbers and of such a character that they would prevent the abuses which might be made of privileges granted to such.

Again, as it was forest conservation, and not forest extension, which was required, he considered the number of foresters employed too high, as Forest-Wardens and not Forest-Masters were the officials whose services were needed; and in accordance with these views he counselled the extension of some of the forest *revieren*, or districts, which were specified, instead of the division of others which were specified as being too extensive.

And he recommended measures to secure the cultivation of good soil, wherever found, and the letting of such ground in Crown forests, though involving the destruction of trees, as whatever might be the value of forest products in the central districts, this could not stand comparison with the products of agricultural labour.

To this report of the Commissioners were attached

several important appendixes. In the fourth of these is given, in tabulated form, explicit information in regard to exports of forest products from Finland from 1855 to 1856. And in the report it is stated that the expansion of the trade in forest products during the period embraced by this appendix showed that a satisfactory forest economy would be of inestimable benefit to trade and commerce of every department, not only in the foreign but the home trade, more especially in giving employment, through shipbuilding, and land and water transport, but also in many ways beside.

In a fifth appendix is given, on the authority of the Forest-Masters concerned, the transport which had occurred of planks and sleepers from the Crown forests, arranged according to the several water routes, with the outlay for transport.

In a sixth appendix is given a statement of the receipts and expenditure in connection with the then existing forest establishment for the administration and management of the Crown forests in Finland, arranged according to the Inspectoral Districts into which they were divided, the data having been obtained from the forest account books in custody of the Imperial Synod, for the years 1860-1868, and other official records which are named.

CHAPTER VI.

FOREST ADMINISTRATION.

SECOND only in importance to the prescription of a system of exploitation appropriate to the conditions of the forests, and the requirements of a country, is the proper organisation of an administrative and executive body of officials to determine what should be done, and to do what is required in the management of the forests in accordance with what has been prescribed. To this subject the Commissioners appointed in 1865 to enquire into the state and condition, the extent and capabilities of the forests in the Grand Duchy, the management of these, and the administration requisite for the development of their resources, gave special attention.

The Crown forests and the Crown parks throughout the land are divided into districts of inspection, which are again divided into *reviers*, or administrative districts, and these again are subdivided into wards, under the charge of wardens, or forest watchers. The districts of inspection are under the charge of Oberforst-Masters; the *reviers*, or administrative districts, are under the charge of Forest-Masters, with the assistance of a Forest-Warden in each ward.

In accordance with the report and suggestions of these Commissioners, the Forest Administration has still its head-quarters at Helsingfors, and consists of a Director-in-chief, who is appointed by the Emperor on the nomination of the Economic Department of the Senate, a forest engineer, a secretary, a chamberlain, a treasurer, and three

Forest-Masters, and the whole service is placed under the Economic Department of the Senate. By this Forest Administration, after due consideration, there was established the system of management finally adopted and now followed. The Director-in-chief, who is at the head of the Forest Administration, has the sole and complete control of the management of the forests. He is therefore required by tours of inspection to make himself acquainted with the state and condition of the forests in the several divisions of the country, and with the work and the efficiency of the forest officials in the discharge of their duties. The Engineer determines the measures to be adopted in the management of the forests, sees to the execution of these, determines divisions, and prepares charts of the Crown forests, and exercises, under the Director-in-chief, the control and regulation of the Forest Administration. The Secretary, who is required to have undergone what is called the higher examination of Government officials previous to appointment, has charge of the minutes and of other similar documents. The Chamberlain attends to the accounts of the Forest Administration, and of forest management, in accordance with special instructions issued 25th June 1869. The Forest-Masters are employed partly in carrying out the plans and the work of the Forest Administration, and partly in the execution of the requisite work in the management of the forests.

Section A.—Forest Protection and Exploitation.

The special function of the Forest-Warden is to protect the forests from waste by thefts, and by the spread of fire in the woods.

There are numerous indications that the forests were formerly of much greater extent than now, if they did not cover the whole land. But as in Europe, so here, the forests have receded in their extent before the advance of man from the south; and not until the latter half of the present

century was the treatment of them brought under satisfactory control.

According to one writer on Finland in the first half of the present century: 'Wherever the population tion is sparse, few in number, and widely scattered, and there is more of forests than can be put to good use by the inhabitants, the management or treatment of the forests is very bad. In Finland the population numbers 400 to the square mile, and as yet everything is left to nature; management there is none. Until of late years forests were of very little value, and accordingly they received little or no attention from the peasants. And this being the case, in dry summers fires were very common, and little trouble was taken to extinguish them. But now the people have begun to manifest a better appreciation of their worth. From of old has it been enjoined by law that the forests should be protected; but the duty has been neglected.'

'Frequently,' says another writer, 'are extensive ravages committed by conflagrations occasioned by the carelessness of the peasants in smoking their pipes and making fires in the woods, and sometimes, it is suspected, intentionally kindled from an interested motive, as the inhabitants are allowed to cut down, for their own use, any trees in the king's forests which have been injured by the burning.'

Both statements are in accordance with what I learned in connection with my enquiries relative to *Svedjande*. There, as elsewhere, it is a grand spectacle which is presented by a large forest in flames, and there is something awe-inspiring in the crash of trees falling, and spreading more widely and rapidly the devouring fire. But in many cases little or nothing is done to arrest the conflagration. The trees are of little pecuniary value; scarcely would the wood repay the expense of transport where no stream is near; nor is it to the poorer inhabitants such a loss as it would be to others. In accordance with the practice of *Svedjande* they scatter the ashes over the soil, sow it with rye, roughly harrow it, and for two or three

years they raise crops where till then the forest stood, until seeds borne by the wind or buried in the soil, restore the growth of wood.

The special function of the Wardens is, as has been stated, to watch and protect the forests. This they do under the direction of the Forest-Masters; and the organisation, established in 1859, is in its leading features still maintained.

In 1859 the Crown forests were divided into 53 *reviers* or districts, each of which was placed under a professional Forest-Master, instructed in forest science, and all of the *reviers* under 11 Oberforst-Masters—the whole being under the Directory at Helsingfors, designated *Forstagrelsen i Finland.* This Forest Administration is moulded on the German model, but the *reviers* were, and still are, much too large, the smallest is one in South Finland, and measures 9900 tunnland; the largest is one in Lapland, and is *five* millions of tunnland in extent.

It may be said that hitherto attention has been given by the Administration chiefly, if not exclusively, to the protection of the forests against fire and theft, and to the sale year by year of sawn timber. Of the Wardens and watchmen, both of whom are of the peasant class, it is only required that they can read and write. But the organisation is good, and has proved tolerably efficient: an efficient protection of the forests has been secured; but by the population generally, and more especially by those who were engaged in the wood trade, the new arrangement was much disliked.

The instructions for the management of the Crown forests, issued on 13th May 1859, were arranged in successive chapters, including severally those relating to—

I. The Forest Administration, the Officials, and the services required of them in connection with the management of the Forest.

II. The Wards into which the Forests are divided, and the duties and privileges of the Forest-Wardens.

III. The Forest *Reviers*, or Districts, and the management of these.

IV. The Forest Treasury.

V. The Sale of Forest Timber.

VI. The Inspection of the Forests.

VII. The Relation of the Governors of Provinces to the Crown Forests.

VIII. The duty of the Central Forest Administration of Land Surveying and Forest Economy in regard to the superintendence of Crown Forests.

In the Third Chapter it is stated in regard to the classification of trees for taxation, Forest-Masters are required to see that the wood be felled and cut in accordance with the classes and designations prescribed as available for different kinds of timber, or only of use as firewood, including in each wood for which inferior wood could not be substituted in accordance with the division into 1, Ship timber; 2, Large timber; 3, Logs; 4, Building timber; 5, Beams or railway sleepers; 6, Telegraph poles; 7, Lathwood; 8, Tarwood; 9, Fencing; 10, Poles; 11, Hoop and stave wood; 12, Charcoal and firewood.

Par. 18 enjoins that the Forest-Masters prepare in the month of June each year a report of what has been done, and a specification and estimate of what it is proposed should be done, in thinning, felling, and planting in the year to come.

Par. 19 enjoins that the sale of timber shall be conducted in accordance with the prescriptions laid down in Chap. V. of the regulations.

Par. 20 enjoins that the Forester or Forest-Master shall keep—

1. A journal, in which shall be entered, in accordance with a prescribed form, a notice of everything which occurs in connection with documents, &c., received and dispatched, and in connection with oral communications

relative to the work; and all documents are required to be filed. In the Form are given in separate columns the date of the receipt of the communication, the contents, or substance of the communication, the date of the communication, and references to the records of what had been done previously or subsequently in the matter.

2. A letter-book, containing a draft or copy of all letters written in regard to the work of the service, arranged in chronological order, and in regularly numbered succession.

3. A day-book, in which shall be entered, in accordance with a prescribed form, all that is done in the work of the service, in the *revier* or district, in the course of the year. In this form are entered in separate columns the year, month, and days, the work done, specifying the block in which it was done, and at whose expense it was executed, and references and remarks, the former showing in what book or document details may be found.

4. A roll book in which, in accordance with a prescribed form, shall be enrolled all the men employed. In the Form provision is made for an entry not only of the name of the person, but of the day of his birth, the day on which he entered the service, the day on which he was sworn, any warning given to him for negligence, &c., a page being kept for each individual, and subsequent engagements entered therein, with an index of the names.

5. A record of days of work done, kept also in accordance with a prescribed form, in which are entered in separate columns the place of work done, specifying the block, the period appointed for its clearance, and the number under which it is entered (*ago nummer*), the time embraced by the work in months and days, the names of the workmen, the days occupied in the following work: floating wood, planting, sawing, collecting seed, road making, fencing, ditching, collecting and burning twigs, thinning and felling timber, the sum of the days thus occupied, the wages in cash, date of reckoning and entry; and as each entry is made, the Forest-Master gives an order on the

forest treasury for payment of the wages, Thus must be recorded the whole of the work done throughout the year.

6. Further, the Forest-Master must prepare and deliver at the end of May a report of the whole management of the forests under his charge, prepared according to a form prescribed, in which are entered on one page the outlay, stating in successive columns, the block to which the report refers, the forest or district in which it is situated, the work done, whether in forest management or in extraneous work, the number of days spent in each of the operations specified in the record of day's work, the sum total of the day's work spent in each and in all, the expense in cash; and on an opposite page is entered the revenue received, in which, in successive columns, are stated the number of the block, the forest or district, and for what it is received, timber delivered, &c., the kind of forest product sold, classified into trunk wood and small wood, giving of each the number of trees and the cubic measurement of what was sold, and the payment received. Directions are given that if the outlay exceed the income the difference must be entered as loss—if the income exceed the outlay the difference must be entered as gain, and the account must be balanced. There must be appended notices of any remarkable transactions or occurrences pertaining to the year in the *revier* or district, such as forest fires, clearances made, devastations occasioned by storms, and the more extensive operations connected with building, fencing, ditching, and sawing.

Par. 21 enjoins that the prescribed work should be effected in the course of the year in the following order:

January.—Wood felling to be carried on when the weather permits, and the delivery or bringing of timber, and the collecting of cones of the fir and the pine continued.

February.—The same operations to be continued—the felling and the delivery or bringing out of timber, more especially of building timber, and the collection of cone s

of the fir and pine, which is the more necessary that in March the seed begins to fall, and the collecting of larch cones should be begun.

March.—Felling operations and the collecting of pine and larch cones, and the delivery or bringing out of timber is to be continued, and an examination of the forest, as extensively as possible, carried out. On places now cleared may the burning of brushwood and refuse twigs be effected, and reports of the preceding year's operations should be completed and delivered to the Oberforst-Masters.

April.—The felling of wood, the collection and delivery of timber, and the collecting of pine cones, should be brought to a close, and the burning of twigs on cleared ground should be completed before the appearance of the leaves ; and the thinning of young wood may be carried on.

May.—Sowing and planting operations may be carried on, and the thinning of young wood completed. Before the close of the month fencing and ditching should be begun, and the burning of twigs may take place if it be a late spring, and the inspection of the forest, and the taxation, assessment or estimate of cubic contents of the timber, in connection with the management of the forests should be made, and arrangements for the sylviculture of the ensuing year should be made.

June.—The aforesaid inspection and assessment, and the fencing and ditching previously begun, should be continued. The seed of the aspen ripens in this month, and may then be collected; and a scheme of operations for the felling of wood during the ensuing year should be prepared and submitted to the Oberforst-Masters.

July.—Fencing and ditching operations should be continued.

August.—Fencing and ditching operations should be continued. The thinning of broad-leaved wood and the leaf harvest may be carried on. Nursery beds may be prepared and birch seed now ripe may be collected.

September.—The collecting of birch seed should be con-

cluded. With the fall of the leaf planting and sowing operations may be begun, and the sales of timber by auction may be begun.

October.—After the fall of the leaf planting operations and the sowing of seed should be prosecuted, Ripe acorns and the seed of the alder may be collected and planted; and towards the end of the month felling operations may be begun, more especially with a view to the thinning of young wood.

November. — Felling operations should be continued, planting and sowing should be completed, and a beginning should be made in the collection of pine and fir cones.

December.—The felling of wood, and the collecting of pine and fir cones should be continued, and the bringing out and delivery of timber should be begun, if transport be practicable.

Amongst other formulas appended are the following: Sale account for the *revier*, in which, on the debit side, are entered in separate columns the date, sales, and balance from the previous year, and remittances received, number of vouchers transmitted and amounts received; on the credit side, the date and amount of payments made, as salaries of officials and watchmen, and workmen's wages, commission allowed and remittances made, and balance, stating number of vouchers and the amounts.

Another is the protocol of auction sales, in which are entered in separate columns the number of the lot, the block in which the wood was felled, the period in which the block was to be cleared, the description of wood to be sold, the number of trees, the contents in cubic feet per piece and per lot, the first bode or offer per tree and per lot, the name of the person by whom it was made, the highest offer per tree and per lot, the name of the purchaser, and remarks—*e.g.*, unsold &c.

A third is the form in which the ledger must be kept, in which, in separate columns, are entered the year within which the operations referred to are embraced, the num-

ber of days' work spent in each of the different operations as already classified, the sum of days' work, the wages, deductions, and expenses, sum of the whole, the kinds of timber sold, classified as stamped timber and as small wood, giving the number of trees, and the cubic contents in each class, the receipts, the gain, or the loss.

A fourth is the account of income and expenditure for forest management of the län or county. In this in regard to income are entered in separate columns the date, the number and name of the *revier*, the sources of income, *e.g.*, wood sold, rents and dues, the number of vouchers and the amount of each, and the sum total; in regard to outlay are entered in separate columns the date, the number and name of the *revier*, the outlay, according as it may have been payments in cash or in kind, for wages, for labourage, for work done by estimate, sundries, and the balance.

And there is given a formula for the scheme of felling and sylviculture for the year, in which are entered in separate columns the period in the rotation of operations in which the block was to be cleared, the fellings in it in the course of the year, the number of the pieces to be felled, the width of the felling, the timber expected to be yielded by it, giving the number and the name of the block, the kind of product named in accordance with the classification prescribed, the number of trees to be felled, the cubic contents of these per tree and per lot, the estimated cost of the operations in days' labour and in wages. Below the entries in regard to fellings are given similar details in regard to sylviculture, there being made in the principal column such entries as these: fields sown with pine seed, root hewing, with the average number of feet obtained, sawing and stripping logs, &c.

The following table represents the extent and distribution of the Crown forests in Finland:—

Inspection Districts.	Reviers or Forest Districts.	Wards.	Area in Tunnland.
Evois Crown Park,		7	18,539
Läns or Circuits of Abo and Björneborg,	6	36	375,802
Läns of Tavastehus,	4	39	80,987
Impilaks-Suistamo,	2	7	131,970
Western Kupio,	4	50	403,691
Eastern Kupio,	6	80	643,477
Western Wasa,	5	62	395,226
Eastern Wasa,	6	65	297,427
Uleä,	4	43	572,533
Kajana,	3	31	1,478,007
Ijo,	4	26	5,089,455
Kemi,	8	90	20,193,972
	52	565	29,681,088

According to reports made by Commissioners appointed in 1865 to enquire into the state and condition of Crown forests in Finland, issued in the years 1866-1868, the extent of land under culture, and the population within the area of these forests, was as follows :—

Inspection Districts.	Number of		Extent in Tunnland or Swedish Acres.			Population.
	Dwellings of Forest Wardens.	Farms and Fields.	Arable.	Meadow	Total.	
Evois Crown Park,	8	20	123	367	490	150
Abo and Björneborg Läns		291	1027	5100	6127	2018
Tavastehus Län,	37	117	590	1843	2433	1042
West Kuopio,	49	90	308	554	862	671
East Kuopio,	77	66	354	1987	2341	726
West Wasa,	49	197	464	1585	2049	1319
East Wasa,	58	99	336	1126	1442	898
Uleä,	43	213	490	2546	3043	1263
Kajana,	11	291	506	1174	680	1544
Ijo,	42	487	261	10112	10373	1453
Kemi,		112	120	2085	2205	722

While for some years the expense of conservation and exploitation was met, or nearly met, by the proceeds of sales, after a time this ceased to be the case.

The revenue from the Crown forests actually received by the State, in marks, which may be reckoned as equivalent to francs, or, in round numbers, as tenpence sterling each was:—

In 1866,	- - - -	154,274 Marks.
,, 1867,	- - - -	142,836 ,,
,, 1868,	- - - -	140,956 ,,
,, 1869,	- - - -	159,871 ,,
,, 1870,	- - - -	230,249 ,,
,, 1871,	- - - -	387,112 ,,

But this revenue did not cover the outlay for salaries, wages, and other expenses, and the Treasury had to make up the deficit to the extent stated below, in the years mentioned:—

1866,	- - - -	214,760 Marks.
1867,	- - - -	222,869 ,,
1868,	- - - -	251,572 ,,
1869,	- - - -	200,592 ,,
1870,	- - - -	126,232 ,,

The following more comprehensive statement, supplied to me by Dr. Blomqvist, shows a somewhat different result:—

TABLE OF REVENUE AND EXPENDITURE CONNECTED WITH FOREST PRODUCTS IN FINLAND TO 1ST JUNE 1882.

INCOME.

	Finnish Marks.
Revenue from the year 1860 to 1875, inclusive,	7,344,635 8
In 1876, - - - - - -	1,353,275 45
1877, - - - - - -	930,318 72
1878, - - - - - -	610,191 38
1879, - - - - - -	617,537 72
1880, - - - - - -	639,141 20
1881, - - - - - -	994,273 85
1881, additional, - - - -	477,974 36
1882, - - - - - -	1,303,698 42
Total, -	14,271,016 18

EXPENDITURE.

	Finnish Marks.
From 1860 to 1875, inclusive, - - -	6,319,531 89
1876, - - - - -	572,513 75
1877, - - - - -	574,507 32
1878, - - - - -	608,339 44
1879, - - - - -	684,716 31
1880, - - - - -	683,604 67
1881, - - - - -	690,102 71
1882, - - - - -	690,102 71
Total, -	10,823,418 80

This shows a net balance of revenue over expenditure of 3,447.598 marks 38 pfennings during the period of twenty-two years. This is altogether a very small clear revenue from so great an extent of forest; but the causes of its being so are numerous. Amongst others, the Government did not wish to sell much, as within the time embraced by this account the delivery from private forests was very great; on the other hand, the Crown forests will, within the immediate future, yield a very greatly increased produce through this restriction of the felling of them; and from the deferred sale it is possible more money may be realised than will compensate for the loss of interest.

In St. Petersburg, to which there is ready access from most places in Finland by water, there is, as has already been intimated, a constant demand for wood; there, both firewood and timber are becoming scarcer than they were, and prices have risen greatly. This is attributable, not to an increased demand, but to a diminished supply, and supplies are being brought from ever-increasing distances. The price of firewood in St. Petersburg has been steadily advancing for a long time; it is now more expensive than is coal brought from Britain; and this is coming into extensive use both in manufactories and in domestic economy.

But, along with the consideration of this, there comes up another phase of the subject. It is the case that, by giving more attention to considerate thinning, and more skilful conservation, and more scientific exploitation, the

produce and the products of the forests might be equalised approximately, if not perfectly; and one object aimed at in the inspection of forests in Finland is to prevent the cutting down of trees from going on faster than the re-growth of these.

Meanwhile the reckless destruction of forests has been arrested, and the forest property has been improved. By Dr Ignatius it is remarked that if Finland, notwithstanding the reckless waste which has gone on, be still a country rich in forests, this is attributable not to the climate and to a soil specially favourable for the growth of wood, but to the fact that more than half of the wooded portion of it belongs to the State. And these forests have not only been preserved to the State, but they have been to some extent improved, and information which may be made available for a greater and more extensive improvement of them has been collected.

Section B.—Forest Conservation and Amelioration.

The object which the advanced forest economy of Europe seeks to accomplish is three-fold: first, to secure a sustained production from the forests; second, to secure along with this an amelioration of their condition; and third, a reproduction of them by self-sown seed when they are felled.

The sustained production and the amelioration of the condition of forests is under the modern method of exploitation, the *Fachworke Method*, as it is called in German, *La Methode des Compartements*, as it is called in France, is —I had almost said, in its application to every single forest—the result of a slowly progressive development, dependent on information in regard to conditions and circumstances slowly and necessarily successively obtained, and this is being collected.

Amongst other data desired by a forester, of whom it is required to determine in regard to the forests of a

country, and of any one forest in particular, the treatment to which they in general, or it in particular, should be subjected with a view to their fullest development, are the rates of increase or of growth of the trees at different ages. Attention was given to this subject in Finland so early as 1829, and an endeavour to obtain such data was made by Mr C. C. Böcker, who published in that year a prize essay, entitled *Skogars Skötoel i Norden*, Forest Conservation in the North. The subject was again brought forward by Staats-rath C. W. Gylden in the year 1853, in his treatise *Handledning för Skogs Hushållare i Finland*, Treatise on the Forest Economy of Finland; and in this tabulated statements of the growth of trees are given.

And in 1867 the Forest Administration of Finland submitted to the consideration of the Imperial Senate the importance, with a view to the development of the forest economy of the country, of this being thoroughly investigated and accurately ascertained in regard to the more important of the trees growing in all the districts into which it is divided. In the subsequent session the means of meeting the expense of such an enquiry were granted. The work was entrusted to Professor A. G. Blomqvist, the present Director of the Evois Forest Institute, whose report entitled *Tabeller framställande utvecklingen af jemnaoriga och slutna skogs-bestand af tall gran och björk. Enlight uppdrag af Forst-strylensen i Finland*, &c., Tables representing the bulk of pine, spruce, and birch, at different ages in different climatal circumstances, with a sketch of the forest management in Finland, was printed in 1872.

In view of the advanced system of forest management devised by Hartig and Cotta, the measurements were to be made, and the tables prepared, in accordance with the usages of their disciples; and instructions were forwarded to the forest officials from the Forest Administration at Helsingfors, under date 6th July 1867. For the purpose of this investigation, Finland was divided into three zones, South Finland, including all from the south coast to lat.

61° 30′ N.; Midland Finland, from lat. 61° 30′ to lat. 64°; and North Finland, from lat. 64° to 68°.

There are given tables of growth in each zone of the country of pine and spruce at all ages, from 10 to 200 years, in periods of ten years, giving the gross increase in fathoms of 100 cubic feet, and the number of trees per tunnland, and the cubic contents per tree. A table of the growth in each zone of birch, giving the ages from 10 years to 100, the number of trees, and the cubic measurement of the timber per tunnland.

There are given in the same tables, in alternate ten years, what is designated *Uttgalbras*, which I suppose to be the decrease occasioned by the felling and thinning, or decay of trees; and by curves are given in one chart a representation of the increase in the cubic measurement per tunnland and of the height of the trees, with advancing age; and in a second the diminution in the number of trees per tunnland with advancing age.

In the body of the work it is stated :—'The diminished growth in height of trees toward the north is seen in the height of first-class trees of 100 years' growth, selected for examinations. The height of those in South Finland was above 83 feet; of those in Midland Finland, about 70 feet; of those in Northern Finland, scarcely 58 feet.

'The average or medium increase of wood in growth of trees of 100 years of age, on the most fertile soil was

In South Finland, - -	99	cubic feet per tunnland.
In Middle Finland, - -	81	,, ,,
In North Finland, - -	50	,, ,,

On spots of medium fertility—

In South Finland, - -	77	cubic feet per tunnland.
In Middle Finland, - -	62	,, ,,
In North Finland, - -	38	,, ,,

On places the least fertile, as on pine moors, which, constituting the greater part of the woodlands of Finland, may be considered as representing the prevailing increase,

In South Finland, - -	55	cubic feet per tunnland.
In Middle Finland, - -	46	,, ,,
In North Finland, - -	26	,, ,,

'The maximum cubic measurement of timber yielded by trees of from 170 to 200 years of age, was found to be, on soil of greatest fertility—

In South Finland,	135	fathoms of 100 cubic ft.
In Middle Finland,	111	,, ,,
In North Finland,	66	,, ,,

On soil of medium fertility—

In South Finland,	105	fathoms of 100 cubic ft.
In Middle Finland,	85	,, ,,
In North Finland,	57	,, ,,

On soil of inferior fertility, such as pine moors—

In South Finland,	75	fathoms of 100 cubic ft.
In Middle Finland,	64	,, ,,
In North Finland,	37	,, ,,

A numeration and measurement of trees felled at mature ages in Middle Finland gave the following results :—

Ages.	Average.	Number of Trees on Tunnland.		Total.
		Hewn Timber, 9–12·2 inch diameter at breast height without bark.	Sawn Timber, Average 12·2 inches diameter at breast height without bark.	
160–170	166	124	43	167
180–190	183	126	53	179
190–200	196	108	75	183
210–220	218	101	90	191

Other researches relating to the development more or less rapid of trees in different parts of the country, have given the following results :—To the south of 61° 30′ lat. pine forests do not yield timber suitable for carpentry work under 60 years' growth on good lands, under 80 years' growth on medium lands, under from 90 to 100

years on poor lands; and timber for saw-mills should be from 100 to 140 years of age. In Central Finland, up to 64°, the growth of trees requires about 20 years more under the same conditions. In fine, in the North they do not obtain firewood or carpentry wood under the age of 120 to 180, or timber for saw-mills before from 180 to 230 years' growth.

CHAPTER VII.

SCHOOL OF FORESTRY.

In the time which has passed since the last-mentioned report of the Commissioners appointed in 1865 to give full consideration to everything relating to the management of the forests and report, was issued, the Forest Administration of Finland has sought to keep the management of the Crown forests of the country in accordance with the ever advancing forest science of the day. And one important means of enabling them to do so by making known the progress of that science, and by supplying officials trained and fitted for carrying out forest operations in accordance with a recommendation of the Commissioners in their report, has been the establishment of a School of Forestry at the Crown Park of Evois in Lampes-socken, in Tavastehuslän in Finland, with a view to giving to foresters thorough instruction in all that relates to the theory and practice of forest economy. It was established by Decree dated 10th March 1859, and opened on the 15th of April of the same year, thoroughly organised, and placed under the superintendence and charge of a director, with three resident lecturers, and one field instructor. Students desirous of enjoying the benefit of the Institution were required to produce before admission a university diploma, or a first-class certificate of the completion of the course of study at a gymnasium. And there was provided for them free instruction, with free quarters and firewood.

After a time the Institution was closed from lack of students; but in 1874 it was reorganised by a Decree dated May 2d, 1874, of which the following is a transla-

tion; and the subjoined rules were laid down by the same high authority:—

'*Helsingfors, May* 2*d*, 1874.—We, Alexander II., &c., &c., make known that since the Economic Department of the Senate for Finland have come to Us with a humble representation as to the reconstruction of Evois Forest Institute, in a manner suitable to the demands of the present time, and with this view have proposed that the instruction in the Institute for the future, while retaining its fundamental plan, should nevertheless be so arranged as to take principally a practical direction; We, in harmony with this, confirmed by what the Governor-General has found to be good on the subject, while abolishing the Decree of the 15th April 1859, concerning the organisation of the Institute, lay down the following directions for the future action of the said Institute:—

'1. The Forest Institute, together with the Crown parks of Evois and Wesijako thereto belonging, shall be placed under the strict superintendence of a Director, who shall likewise participate in communicating instruction, and who shall conduct the practical exercises of the pupils in the field; besides him a Teacher shall be installed in the Institution, who shall aid the Forest-Master for the said Crown parks in the practical instruction of the students.

'2. The Director and Teacher shall be entitled to a pension for themselves, their widows, and children, according to the rules laid down for the Civil Service. While the Director shall be nominated by Us, on the suggestion of the Economic Department of the Senate, the Teacher is to be installed by the said Department of the Senate as soon as the service in the prescribed order renders it necessary.

'3. Exclusively of the higher scientific ends for which instruction is communicated, in the future instruction shall be given in forest science, geology, the science of engineering, agriculture, forest law, map drawing, and linear drawing.

'4. The number of the ordinary pupils, the extent of

the curriculum, the division of the subjects of instruction amongst the teachers, the course of lessons, and the proper hours, shall be, on the representation of the Forest Administration, determined by the Senate.

'5. As a condition for reception into the Institute, there is required a certificate of good character and Christian knowledge, and either a student's certificate from the Alexander University, or a full certificate of dismission with approval from some one of the public or private schools of the country. Pupils, on the ground of such certificate, have to record themselves as prepared to undergo the student's examination, and prove then that they possess a well-grounded acquaintance with the mathematical sciences, together with the knowledge prescribed for Land-Surveyors and Forest-Masters, or they must produce other well-authenticated evidence of their well-grounded knowledge in the last-mentioned branches of science.

'6. Every pupil shall at the time of his inscription pay into the Institute 40 marks; but he shall receive for this free instruction, lodging, and heating.

'7. The Institute shall organise two classes, so arranged that a complete course shall be gone through in two years.

'8. A pupil may not remain in the Institution longer than four years. The lectureships held by the three ordinary lecturers who have hitherto been employed in the Institute, and whose office has been abolished by this decree, shall not be continued after the decease of the present holders; but these are nevertheless bound until they obtain another situation, or go in any other way out of service, to communicate instruction, each in his own branch, to the pupils of the Institution who present themselves for this end, with the approval of the Director, to obtain the said instruction along with the above-mentioned practical course. In connection with this, We have, upon the said representation of the Senate, chosen to allow that the highest three of the Forest Conductors who have gone through Evois Forest Institute, and by preference those who have distinguished themselves, shall receive till fur-

ther notice a yearly payment of 800 marks, which payment, from the Finnish public chest, each of these Forest Conductors shall enjoy for a period of three years, so long as there is no demand for ordinary service, with the obligation to be at the disposition of the Forest Administration, instead of the regulation payment now made of four marks a day: it being provided that the Senate, when the number of the forest conductors or other circumstances make it possible to reduce these payments, may bring the matter again before us.

'Finally, We leave to the Economic Department of the Senate, in regard to the said ordered reconstitution of Evois Institute, to take order for the complete carrying out of these rules.

'*Helsingfors, May 2d*, 1874.—According to His Imperial Majesty's own determination, and in his high name, the Executive Senate for Finland.—(Sd.) R. Furnhielm, H. Molander, A. Mechelin, T. H. Thilen, Oscar Norrman, F. Walmquist.

'Rules laid down by His Imperial Majesty for Evois Forest Institute, given in Helsingfors, May 2d, 1874:—

'We, Alexander II., &c., make known in accordance with the special decree already issued, that Evois Forest Institute shall for the future obtain an altered organisation, and We have found good to lay down the following rules for the action and management of the institution,

'Chapter I.—The object and management of the Institution.

'Section 1. The Institute has for its purpose to communicate theoretical and practical instruction in all that belongs to forest science to those who wish to devote themselves to forestry, and to obtain the necessary education and training for this.

'Section 2. As experimental ground for the exercise of the practical work of forestry, there are appropriated Evois

and Wesijako Crown parks in Tavastehus Län, and the school erected on this last through the care of the Institute, besides which the necessary botanical gardens, together with the plantation of native and foreign trees, shall be created and maintained.

'Section 3. The Institute shall be placed under the direction of a Forest Bureau, whose duty it shall be to follow with attention the action of the Institution, and to arrange and conduct its business in conformity with these rules, and the further prescriptions which may with this view be communicated by the Imperial Senate.

'Section 4. The Forest Bureau shall inspect yearly the teaching of the Institution, and in conformity with this shall report the result to the Imperial Senate; and after the present regulations shall have been altered, they shall send a plan or programme of the study proposed, exhibiting the duration of the course of lectures, and the division of the subjects and hours of instruction amongst the teachers.

'Section 5. It belongs to the Director of the Institute to watch over its business, to see that the plan of the instruction is carried out, to control its management, and together with the teaching body to exercise discipline, and to carry out the arrangements as to the teaching and pupils, to engage and to discharge the servants of the Institution, to fulfil the duty of head Forest-Master in the parks of the Institution, and to participate in imparting the instruction given.

'Chapter II.—The Teachers.

'Section 6. It belongs to the ordinary Teacher in the Institute, besides carrying out the instruction in the subjects according to section 24, to exercise the function of secretary and librarian; and besides attending to the management of the cash in the Institute for Evois and Wesijako Crown parks, he must keep the accounts of the Institution.

'Section 7. The Forest-Master for Evois and Wesijako Crown parks is bound in return for receipt of the appointed

sum laid down in the arrangements of the Institution, to communicate instruction in the Institution in the branches of knowledge mentioned in section 24, and together with the others, to initiate the pupils in the purely practical work of Forest-Master. Further, the Forest-Master has on demand, and on receipt of prescribed payment, to communicate to the foresters of landed proprietors instruction in forest management.

'Section 8. Those seeking the office of Teacher in the Institution must have a general humanistic culture, and must have gone through a complete course in a Finnish or in a well-known foreign Forest Institute, and must possess moreover appropriate skill in the subjects to be taught by him. When the office of Teacher is sought by a person whose practical skill cannot be otherwise confirmed, he may, if it be judged necessary, be appointed provisionally for a trial period of at least two years, during which he shall have the benefit of all the privileges of the office, and thereafter if his services be found satisfactory, he may be confirmed in the office.

'Section 9. The Director shall be named and removed by Us on the mention of the Imperial Senate; but the Teacher shall be installed by the Senate according to the manner already prescribed.

'Section 10. The Director and the Teacher shall be sworn into office before the Chief Director of the Forest Bureau.

'Section 11. In the absence of the Director, or if he is otherwise prevented from fulfilling his duties, the Forest-Master shall represent him in the duties of his office. In case of interruption of the duties of the Teacher or Forest-Master for a short time by illness or otherwise, the Director is bound so to act that the pupils may be in some way properly employed. But if the interruption continues more than fourteen days, it is to be reported to the Forest Bureau, in order that proper arrangements may be made.

'Section 12. The Director and the Teacher are entitled to similar pensions for themselves, their wives and children, as other officials of the same standing.

'Chapter III.—The pupils.

'Section 13. Those who wish to enter the Institute as pupils have, after the official notice of the vacant places in the Institute has appeared in *Finland's Allmanna Tidning*, to lodge before the 1st July with the Director a written request accompanied by the following documents:—

'(*a*) A certificate of moral character from their minister.

'(*b*) A medical certificate as to their bodily constitution and their vaccination.

'(*c*) A student's certificate from the Alexander University, or a certificate of completed study from any of the country's public or private schools. Such pupils at these as have finished their course are entitled to enter themselves for the students' examination at the university on the ground of said certificate, and their possessing a good knowledge of the mathematical sciences, together with a sufficient acquaintance with land measuring and the duties of a Forest-Master, or other authenticated certificate as to a sufficient knowledge of the above-mentioned branches. Together with these they are required to produce—

'(*d*) An engagement on the part of the parents or of some other respectable person to be responsible for the pupil's support in the Institute.

'If the applicant be under age, these papers must be accompanied by his parents' or guardian's written approval of his intention to enter the Institute.

'Section 14. The number of ordinary pupils shall be determined by the Imperial Senate on the representation of the Forest Bureau; should persons desire to be admitted to the Institute without any of the certificates mentioned in rule 13 (*e*) provision is made for their going through either a part of the course of study followed at the Institute, or the whole of the course if opportunity permits, on the special representation of the Forest Bureau, with the concurrence of the Imperial Senate, that these persons may be received into the Institute as extraordinary pupils. The Director is bound yearly before the 15th May to advertise in the *Allmanna Tidning* respecting the vacant places for

pupils in the Institution, and what concerns the same.

'Section 15. The request for admission to the Institute, given in to the Director before the prescribed time according to rule 17, and the other documents therein specified, must be handed by him without delay, together with his own opinion on the same, to the Forest Bureau, whose duty it is to decide who shall be received as pupils, and by preference those who are properly certificated; and the Bureau is bound to inform both the Director and the pupils who are accepted.

'Section 16. The name of each pupil must be inscribed at his entrance in the matriculation book of the Institute, with the record of his number, name, birthplace, and date, what school he has attended, the nature and contents of the certificate, together with what preparation the pupil has had beforehand. In the matriculation book shall also be indicated when the pupil has fulfilled his course, his position in the Institute, his progress in knowledge, and a judgment as to the skill he has acquired.

'Section 17. Each pupil shall pay at his entrance into the institution forty Finnish marks, which sum shall be applied to procuring books, periodicals, instruments, &c., and which money shall be accounted for by the teacher, according as provided for in sections 38 and 39.

'Section 18. The pupils receive free instruction, lodging, and heating in the Institution, but they must provide themselves with bedclothes, meat, and light, according to the regulations of the Institution fixed by the Forest Bureau.

'Section 19. Extraordinary pupils are subject to the same rules and regulations as those prescribed for ordinary pupils.

'Section 20. Pupils who have not in the time prescribed in section 25 obtained sufficient knowledge to entitle them to the degree of Forest Conductor, may, with the consent of the Director and Teachers, remain in the college for other two years.

'Section 21. In the case of persons under age they may not be discharged from the Institute before their course is

finished and the certificate of completed study is given them, without the written consent of their parents or guardians.

'Chapter IV.—The instructions, the examinations, and the certificates of proficiency.

'Section 22. The year of instruction in the Institute begins on the 15th August, and is divided into two terms; to wit, the autumn term, from the 15th August to the 15th December, and the spring term, from the 15th January to the 15th June. The pupils must, under the guidance of the Director, the Teacher, and the Forest-Master, carry out for the sake of practice the measuring of the fields and wood, as also the estimating of wood during the time from the 15th July to the 15th August. During the terms and times of exercise the pupils shall have Sundays, and holidays during the Easter festival.

'Section 23. Instruction with practical exercises shall be communicated in the Institution on the following subjects:

'(*a*) Forest science.

'Encyclopædic view of forest science, modern doctrine relative to the planting and restoration, the protection and the management of woods, and doctrine relative to the economy and rules for cutting the same.

'Forest technology.

'Forest mathematics.

'Forest taxation—or determination of quantity of produce to be withdrawn.

'Forest botany, together with the anatomy and physiology of arborescent plants.

'Zoology, in so far as it relates to animals to be found in Finland which are profitable or disadvantageous for woods.

'The science of hunting.

'(*b*) Geodesy.

'Land measuring, with special respect to the requirements of forest service.

'Levelling.

'(*c*) Science of engineering.

'The construction of country houses, bridges, roads, and dams.

'The draining of lakes and mosses.

'The construction of floating barriers and such like, together with the manner of floating timber.

'(*d*) Rural economy.

'The most general rules of agriculture, and especially what relates to the soil, the taking land into cultivation; and the management of meadows and enclosures.

'(*e*) Legal economy.

'Legal rights of lands, as well as of ground and buildings, in regard to which information is needful for the forester, together with legal arrangements relative to woods, fishings, huntings, waterways, and waterworks, and to the floating of timber.

'(*f*) Drawing.

'Map drawing and linear drawing.

'Section 24. The complete course in the above-named subjects shall embrace two years or four terms; and instruction shall be communicated to the two classes by the Director, in legal economy, and in that part of forest science which is not taken up by the Forest-Master. By the Teacher instruction shall be given in geodesy, rural economy, and drawing; and by the Forest-Master in forest mathematics, the doctrine relative to animals profitable or destructive for wood, the science of hunting, and the sciences of engineering. The hours of teaching shall be divided for each class and each subject and teacher in accordance with the following table:—

Teachers.	Hours in the Week.		Total.
	1st Class.	2nd Class.	
Director, - - -	7	7	14
Teacher, - - -	7	7	14
Forest-Master, - -	7	7	14
Total, - -	21	21	42

'The hours of teaching are from nine to twelve in the forenoon, and three to four in the afternoon, including in these lectures, repetitions, examinations, and practical exercises, with which last named pupils are required to occupy themselves in order to obtain freedom and experience in the work.

'In regard to special experience which certain of the staff of instructors may possess in special branches of the above-named sciences, there may, on the representation of the Forest Bureau, be certain modifications made in the above-presented division of the subjects of instruction amongst the teachers, with the reservation that the said alterations shall be taken into the programme in accordance with the rule in the next section.

'Section 25. It belongs to the duties of the Director, in council with the Teacher and Forest-Master, to make a programme of study, grounded on what is laid down in sections 23 and 24, for each year, as indicative of the duration of the course of instruction, and also a table of lessons containing the teaching hours in the week, with a division for each branch of science and teacher; and this programme before the end of May must be sent to the Forest Bureau, which, besides examining it themselves, shall submit it to the Committee of the Imperial Senate entrusted with superintendence. And it belongs to the Director also to watch over the fulfilment of the programme as confirmed, and the course of the table of lessons, and in general to see that the pupils obtain practical acquaintance with their subjects.

'Section 26. The pupils' progress in the different sciences shall be judged according to the following scale: *very distinguished; with recognised distinction;* and *good;* by which characteristics the pupils' diligence and activity shall be marked in their certificate of completed study.

'Section 27. Each year, at the end of the spring term, there shall take place a public examination, under the control of the Chief Director in the Forest Bureau, or in the presence of one appointed by him, of the pupils of the

Institution; in regard to which examination a month previously an advertisement shall, by the Director's care, be inserted in the official gazette of the country; and a special notice of the examination shall be sent in to the Director of the Agricultural Department of the Imperial Senate. In this examination, which should not extend over three days, questions shall be put to the pupils in all the theoretical and practical subjects of instruction in which they have been instructed during the course of the year, and the pupils ought also to give proof at the same time of their acquaintance with, and their expertness in, the work of a practical forester.

'Section 28. The pupils in the second or higher class who wish to obtain a certificate of study from the Institution shall, before the public examination takes place, be subjected to examination by each teacher.

'Section 29. Immediately after the close of the examination the Director and Teacher shall come together in the presence of the Chief Director or his deputy for the consideration and determination of the following matters:—1st, what character shall be inscribed on the certificate of each pupil; 2nd, which pupils shall go out of the Institution either with a complete diploma as forest conductor, or merely with certificates of study and progress; 3rd, which pupils can be removed from the first to the second class. The determination come to shall be inserted in the matriculation register, and publicly read out to the pupils.

'Section 30. The diploma for the degree of Forest Conductor shall be written out and subscribed by the Director and by both the Teachers, and must contain the results given as above of his examinations. To the pupil who wishes to leave the Institution without having been approved by public examination, the Director and both of the Teachers shall conjointly give him a certificate, wherein in accordance with the matriculation register shall be set down in full what knowledge he brought with him at his entrance into the Institntion, the time he has

availed himself of the instruction of the Institution, and the degree of proficiency he has shown in each branch, as well as his diligence and ability.

'Section 31. If the pupil be compelled from any other cause to leave the Institution before the course is completed, or the yearly examination has taken place, and should wish to receive a testimonial from the Institute, such shall not be refused, but it shall be drawn out in the above-mentioned way, with special reference to the occasion of the pupil's leaving the Institute.

'Chapter V.—The discipline.

'Section 31. It is hereby laid down, in accordance with section 5, that the management of the Institution belongs principally to the Director; it belongs also to the Teacher to support the Director in this, but particularly in his control over the pupils.

'Section 32. When weightier questions arise, the Teachers may be called together in council at the instance of the Director as president, in order to examine and decide the plans laid before them by the Director; the determination in this case shall be in accordance with the voice of the majority.

'Section 33. The pupils are bound to show respect and obedience to the Director and Teacher; and to conduct themselves courteously, and to show a respectable moral character; to appear punctually at the lessons; to listen with attention and diligence to the instruction; to perform the exercises which are prescribed, and to conform carefully to the various prescriptions and arrangements of the Institution. Without the Director's permission no pupil may leave the Institution.

'Section 34. With respect to breaches of discipline on the part of the pupils the following punishments are prescribed:—1st, a simple reprimand from the Director; 2nd, summons before the college of teachers; 3rd, rustication from the Institution for a half-year; 4th, expulsion. The first and second punishments may be determined by the

Director, removal for a short time, or expulsion, must come before the college of teachers, who, in special cases, are bound to place the matter before the Forest Bureau, and await their decision; if the punishment be expulsion, this shall, in the case of a pupil under age, be communicated to his guardian through an extract from the minutes. Punishments three and four are to be mentioned in the register of matriculation.

'The service of the Institute shall be under the direction of the stewart, of the Director, &c., &c.

. . . . . .

'Chapter VI. — The Institute's buildings, furniture, instruments, and other helps for instruction.

'Section 35. The buildings, the fire-engine, and the implements of the Institution should be carefully repaired and preserved; and the Director is bound, twice a year, in May and October, in company with the Teacher and a good carpenter and mason, to examine the whole buildings and fireplaces, on which occasion all damages are to be noted, and estimates made for their repair. In case of greater repairs being wanted, the Director must send without delay the documents containing the examination and estimate to the Forest Bureau, to be by it handed over to the Head Bureau for Public Buildings, so that the said Bureau may take proper action in regard to the matter.

'If the damages are of a less important character, but such as do not lie with the person who lives in the house to repair, the Director can then see if the repairs cannot be made through an advance from the means supplied for the extraordinary expenses of the Institute. Nevertheless, the Director shall every half-year report such extraordinary expenses to the Forest Bureau, with a view to sums thus advanced being properly met. It is the duty of the Teacher to make with respect to all such buildings, inventories, which shall be sent in every fifth year, at the end of February, to the Forest Bureau.

'At other times a supplementary account has to be sent in yearly, at the same time of the year.

'Section 36. The collections and property of the Institute must be accurately valued and recorded. These are:

'1st. Forest instruments and tools; and the botanical, forest, technological, chemical, and mineralogical collections of the Director;

'2nd. Models of buildings, and the physical and zoological collections of the Forest-Master; together with

'3rd. Instruments for geodesy: and these, together with the inventories, are to be kept in the archives of the Teacher.

'Section 37.—The Director ought, after taking counsel with the Teacher, to buy such books, treatises, and plates for the library of the Institute as will serve to the completion of the instruction.

'It rests on the Director to determine when the library is to be opened for the loan of books.

'Chapter VII.—The management of the moneys of the Institution, and the accounting of the same.

'Section 38. All dues and other revenues which accrue to the Institute shall be received and accounted for by the Teacher, and he may not defray other expenses from these means than those which have been approved by the Director. These the Teacher shall defray according to the determination of the Forest Bureau.

'The Teacher shall keep a proper cash-book, which shall be balanced every month, after due audit by the Director, and comparison of the balance with the cash in hand. An extract from the cash-book shall be handed over every month to the Director, who must hand the same to the Forest Bureau before the 8th of the following month.

'At the close of the year a complete account shall be made up by the Teacher of the money under his management; which account, after proper audit, shall be handed in to the Forest Bureau; and after the account has been

examined, and checked by the Forest Bureau, it shall be handed in to the proper department of the Imperial Senate.

'Section 40. In case of the resignation or death of the Teacher, it shall belong to the Director to keep the cash account, and superintend the book-keeping and the other official duties and effects of the Institute. Should there be any deficiency in the cash, or other defect, it is the duty of the Director, as part of his responsibility, to lay this as soon as possible before the Forest Bureau, together with an account of what is missing; and it belongs to the Forest Bureau, on occasion of the same, to take the proper steps to preserve the rights of the Crown.

'To whomsoever the above concerns, Helsingfors, 2d May, 1874, in His Imperial Majesty's name. (Sd.) K. Furnheilm, Th. Thien, H. Molander, Oscar Norrman, A. Mechelin.

'F. WALMQUIST.

'Payments in the Evois Forest Institute, as laid down by his Imperial Majesty:—

	Finnish Marks.	
Director's salary,	3,600	
Board wages,	1,600	
Allowance for horse,	400	
		5,600
Teacher's salary,	2,000	
Board wages,	1,000	
Allowance for copying,	200	
		3,200
Forest-Master's wages in Evois and Wesijako Crown parks, for assistance in the instruction of the Institute,		1,000
Allowance for a boy and two firemen, estimated at		1,200
Light, writing materials, books, newspapers, furniture, and inventories, estimated at		1,000
Cutting of wood,		1,200
Support of buildings,		1,500
Total,		14,700

'*Remark.*—The Director, Teacher, and Forest-Master,

together with the servants of the Institute, have free lodgings and a right to graze—the first three two cows each, and the last one cow each. Besides this, the Director, Teacher, and Forest-Master shall have the use of a *tunnland* in the neighbourhood of the Institute, and the servants a *mark* for potato ground. If any of these persons wish further to rent property appropriated to the Institute, they will obtain the same by applying to the Imperial Senate, and paying money in to the chest of the Institution.'

In reply to inquiries which I addressed to Dr Blomqvist, the Director of the Institution, some years ago, he wrote to me as follows :—

'Our Institution at Evois is by much too limited and inconsiderable to be taken as a pattern for any other place. It was reorganised, in 1874, so as to cost as little as possible. The number of teachers was then reduced. But this I look upon as a mere temporary arrangement, and therefore I may state at the outset that it is the original organisation adopted in 1860, when the Institution was founded, to which I refer in the following statement.

'At that time there was a Director, who was also a teacher, and three other teachers,—one for forest science, one for natural history and chemistry, and one for mathematics; a Forest-Master or Forester, who also was a teacher, and a Drawing-Master, who was also secretary and librarian —in all six teachers.

'The subjects on which instruction was given at that time were then, as now—

'I. Forest sciences : *Wald-bau* [sylviculture], *Forst-taxation* [forest management and regulation of the quantity of forest produce to be obtained], *Forst-technicologie* [technical properties of different kinds of wood, practical felling of trees, treatment of the timber mechanically and chemically, transport of the same by land and water, &c., &c.],

National Ekonomie [political economy], with a special view to the treatment of forests so as to promote the prosperity of the community, *Forstliche Rechtskunde* [the existing laws and regulations relative to forests, game, and fishing, the rights of property, &c.]

'II. Physical science: forest botany, forest zoology, and elements of mineralogy and of geology.

III. Geodesy, or land surveying, mainly practised by exercises in measurements in forests throughout the summer.

'IV. Rural economy: general instructions in all matters relating to agriculture, &c.

'V. Civil engineering: principally road-making, and construction of pontoons and floating bridges.

'VI. Forest mathematics, or the application of mathematical principles to forest economy.

'VII. Park-keeping and scientific administration of forests.

'VIII. Drawing of maps, charts, and plans, and practical exercises, &c., in all forest work, and everything also relating to the management of State forests.

'These are all still the subjects of study; and previous to entering the Institution every student must have passed the final examination at the University of Helsingfors; and therefore he must have become acquainted with the first elements of the various branches of physical science, so that all the studies here are now directed towards the practical and professional application to forestry of what has been attained previously and otherwise.

'From the 15th of June to the 1st of November nearly the whole time is spent by the students in practical work in the forests, principally in measuring forests, preparing charts, and in works of *taxation*, as explained above.

'During the months of winter lectures are delivered, as in the university, and thus are occupied at least twenty-one hours a week. A special law enjoins that the students

shall be well instructed in the preparation of charts, and that they shall be kept fully employed.

'Formerly, besides the instruction which has been specified, and which is still given, systematic instruction was given to a greater extent than now in general botany, and in general zoology, in mineralogy, and geology, and in chemistry, mechanics, and natural philosophy.

'The last-mentioned subjects have now been given up, and the others are treated only cursorily.

'The course of study now, as formerly, extends over two years. The existing organisation is defective, and at least two additional teachers are required. At present there is only the Director, who gives instruction in forest science, political economy, and forest law, which appointment I hold; a Teacher of land surveying and rural economy, and of book-keeping during the winter months; a Forester (*forst-meister*), who is at the same time teacher of forest mathematics and of civil engineering.

'Besides these we have only a lecturer on natural history and one assistant Forester—in all five men, four teachers and one assistant.

'Since the 1st of November last (1876) there has been opened also a school for twelve peasant pupils to be trained as Forest-Warders, who are trained principally in the practical work of forest workmen; but during the winter they spend nineteen hours a week in theoretical studies.

'One consequence is that we all, and especially I, are so much occupied that little even of our spare time can be devoted to literary work. A work of some importance, upon which I have the labour of some years, lies by me unfinished for lack of leisure to complete it. But we hope for a good time coming.'

For instructions in practical forestry the students make frequent excursions in the course of the winter into the neighbouring forests to see the felling of trees; in spring they do the same, to see, and to take part, in sowings and

plantations, the collecting of mineral, vegetable, and zoological specimens, measuring of trees, taking levels, &c., and in the floatage of trunks to a saw-mill moved by steam-power which is established at Evois; and in summer the field work is prosecuted from 15th July to 1st October in some one or other of the Crown forests, under the direction of the Director or Principal, and one of the teachers. The forest is surveyed, measured, described, and inventoried, with detailed information in regard to the condition and cubic contents of the trees. This is done by each student for and by himself. When I heard last this was being done in the parish of Salmis, on the border of the Russian government of Olonetz. In the month of October they are exercised in taking levels for the making of new roads, and for the draining of lakes and marshes, and also exercised in what relates to the chase. And in the winter each student devises a complete plan of operations such as he considers appropriate to the forest surveyed, again as in the forest, preparing by himself in the Institute the charts, inventories, estimates, and scheme of operations to be prescribed. In this way are prepared every year diagrams, &c., of from 2000 to 5000 tunnland of forest.

At the National Exhibition held in Moscow, in the summer of 1882, there was exhibited a chart of the forest in connection with the Institution, indicating the management followed, and the distribution of the different kinds of trees growing, and the forest masses in which they grow. It had been originally produced for actual surveys as an exercise of the students in the Institution on a scale of 1-80 (the scale usually followed in Finland), and extended on a scale of 1-2000.

As has been stated in the preceding chapter, the object which the advanced forest economy of Europe seeks to accomplish is three-fold: first, to secure a sustained production from the forests; second, to secure along with this an amelioration of their condition; and third, a reproduction of them by self-sown seed when felled. The plan

of operations deemed suitable for a specified forest, which students at Evois are required to prepare, is prepared in view of this three-fold object, and the surveys, charts, inventories, and estimates for which information is collected in the forest in question during the autumn, are all prepared as data required for this plan of exploitation and treatment. And it may be assumed that forest *reviers* which have been for years under the management of Foresters or Forest-Masters so trained must be in an improved condition.

The number of students has increased from 6 to 24; the students designed for Forest-Wardens are at present 14 in number, but they will shortly be increased to 24.

The first Director of the School of Forestry at Evois was Colonel Alexander de Forselles, who may be said to have founded the school; but the first regulations were drawn out by Staats-rath C. W. Gyldens, and by him Dr A. G. Blomqvist, the present Director of the school, was appointed secretary and adviser. Till 1870 the Directorship of the Institute was held by Colonel Forselles, and Dr Blomqvist was lecturer on forest science. In that year Colonel Forselles was appointed Chief of the forest department of Finland, *Cepverdirektor foer Forstvoesendet.* Previous to his appointment as Director of the Institute he was distinguished as a military engineer. He was a man of great inventive powers and administrative faculty, and his name became associated with an instrument he constructed for measuring the height of trees, which was based on a new idea. The present staff of instructors is composed of:—Dr A. G. Blomqvist, Director; Magister J. E. Furuhjelm, instructor in physical science; M. C. A. J. Nybers, instructor in geodesy, agriculture, and drawing; M. H. Hackstedt, instructor in mathematics, engineering, and forest science; Forest-Master A. B. Heikel, instructor in the school for Forest-Wardens; in carpentry and manipulation of wood in the workshops of the guards and in the forests, Instructor K. Oksanen.

The Finnish School of Forestry is situated, as has been stated, at Evois. The following is an account given by Dr Hough, Chief of the Forestry Division of the Department of Agriculture at Washington, of a visit paid by him to this institution in the summer of 1881 :—

'August 9, 1881.—The steamer Aura, in which we had embarked for crossing the Baltic from Stockholm to Abo, was named after a principal river in Western Finland, and at first sight appeared hardly safe for such a passage. The forward deck was low, and the whole arrangement seemed to fit it for river navigation rather than a sea voyage. She proved, however, to be well enough suited for the occasion, for her route lay the whole distance among islands, for the most part thickly dotted over the surface, and consisting of naked gneiss rock, or of low rocky islets, densely covered with pine and spruce. They strongly recalled the familiar scenery of the "Thousand Islands" of the St. Lawrence, whose history and legends we had collected and published a year or two before, but they differed from these in being some hundred times more numerous, and most of them appeared to be uninhabited. In a more open part, and probably near the national boundary, there was a light-house ; but besides this, the only aids to navigation were cairns, signal poles, and painted rocks, which were well enough suited for clear weather and daylight; but this route would be wholly unsafe in a fog, and as for daylight it extends through the greater part of night in summer, while in winter it is frozen solid throughout.

'Many times the way seemed closed on every side, and we appeared to be running recklessly against a rock, when by a sudden turn a dozen passages at once opened in as many directions, with long vistas affording an endless variety of scenery of the most beautiful kind. We passed several small parties of Russian engineers, engaged in hydrographic surveys, and touched at one or two landings. The maps show that this archipelago is divided up into parishes, and there is probably a considerable population upon the

islands, although scarcely a trace of cultivation could be seen. At one point the steamer upon signal slackened a little, and there came out from behind an island a small boat containing several stout young men and one elderly woman. The men all came on board the steamer, with their little baggage; a parting adieu and tear told, in the universal language, of a family tie separated, if not sundered for ever, and the woman returned alone to the shore.

'The captain was sociable and inquisitive, and upon our enquiring for Evois, he said it would be found in the suburbs of Helsingfors, half a day's voyage beyond Hango. Arriving at Abo, on the afternoon of the 10th, we spent several hours in looking about the city. It has a population of about 22,000, and is the seat of a Naval Academy. The preparations for a National Exhibition were going on, and our steamer brought a large number of agricultural machines and the like, intended for display. At a bookstore we found an elaborate map of the country, and then ascertained with certainty that Evois was at least a hundred miles north of Helsingfors, and thirty miles from the nearest railway station at Tavastehus, with no regular line of conveyance between.

'Getting under way, with the first appearance of daylight, which here means between one and two o'clock in the morning, we continued our route among the islands, and late in the forenoon arrived at Hango, from whence a railroad runs by an inland route to St. Petersburg. As the steamer was approaching the wharf a group, consisting of two ladies and several gentlemen, stood looking intently, as if expecting the arrival of friends, and upon an answer to their enquiries from the captain, all eyes were directed upon the writer, who stood upon the wheel-house by his side. It was presently known that one of these ladies was a sister of Director Blomqvist of the School of Forestry at Evois, who having been informed from Stockholm of our intention to stop there, had come to advise going on to Helsingfors. One of the gentlemen was Professor Doner,

of the University of Helsingfors; and as he spoke English fluently, and was going on with us, he was soon on sociable terms with all the Americans on board. Two hours or more were spent very pleasantly with this party, visiting points of interest at Hango, which is little else than a long, narrow, rocky promontory, with a railway station and a few summer hotels. It is somewhat noted as a place of fashionable resort in the warm season, and has considerable quarries of red granite. Upon an island some distance in front the Russian flag floats over a strong fortification, that would meet the first attack from a foreign naval power. The other lady of the party was the wife of the Governor at Tavastehus, who assured us of his kind reception upon arriving at that place.

'From the map purchased at Abo, and by the aid of Professor D., we got a very intelligent idea of the communications of the country, and upon our landing at Helsingfors we received from him and his brother, who was the American Vice-Consul, the most courteous attentions, and most excellent advice. The city is the capital of Finland, and has a population of about 46,000. Besides containing the only university in the country, it is the centre of considerable commerce and inland trade. Finland, although subject to Russia, is in every thing but military dependence, self-governing throughout. The Emperor is *ex officio* the Grand Duke, but every thing is left with a local Governor and Parliament. They have their coinage, their postal service, their import duties, and their finances, quite independent of Russia, and the country shows many traces of the laws and customs of Sweden, to which before 1809 it belonged.

'We received from Professor Doner a letter to General E. d'Ammondt, of the Emperor's suite, Governor of the Province of Hamenleena, and as we got seated the next morning in the railway car for Tavastehus a young Russian military officer took his seat in front. He inquired in English if the writer was not going to Evois; and at every station where we stopped he was at our side. He mentioned the

time the train was to wait, and answered every inquiry politely, but was not otherwise sociable. It *may have been* a voluntary civility on his part—it was at least no unpleasant incident. He turned off on a branch road before reaching Tavastehus, giving particular advice before he left as to the remainder of the way.

'We were received by the Governor with the utmost politeness; his beautiful and accomplished daughter, who spoke the English language with great purity, being called as an interpreter, and we were furnished with his carriage and coachman for the remainder of the journey. He sent with these to our hotel a letter in English giving the distances between stages where horses would be changed, and the sums that the peasants would expect for their teams. It was the merest pittance—about a quarter of a dollar for two horses and a man for six or seven miles. As the carriage came in at a stopping-place, which was generally a group of low, flat log houses and barns, arranged around a court or yard, one or two young men would start off for the pastures to bring up a fresh team. The carriage, harness, and driver, went through, while the peasant would ride back to the place where he had started. As the latter took his seat by the driver we noticed that he generally had his bridle thrown over one shoulder, with several large annular cakes of coarse, unleavened, black rye bread strung upon it. These, at the end of his route, he would divide with his horses as their lunch, giving a mouthful to one and then the other, occasionally keeping one for his own eating. At each station the traveller was requested to enter in a book opposite his name the time of his arrival, his destination, and any complaints he might have to make as to the service. The driver had instructions to go through to destination, and to await our pleasure for return.

'This journey of thirty miles led over an excellent road, through a cold and to some extent a swampy country, but otherwise well cultivated, the crops being barley, peas, oats, potatoes, turnips, and flax, with meadows and pas-

tures, but no fruits other than currants and berries. There were considerable bodies of woodland, and here and there a village of log huts. The population was sparse, and a general air of poverty prevailed. It is, indeed, geologically, a region that has but recently emerged from under the glaciers, and abounds in lakes and ponds. We noticed several high slender stacks of leaves put up for winter feed, and there were various indications of long and cold winters; for this is in over 61° of North latitude, and under the same parallel as Greenland, and the northern shore of Hudson's Bay.

'The public highway appeared to end at a gate; but on passing this, and no longer fenced, the carriage-way led by easy curves, through a well-kept woodland, with here and there a little lake, until a mile or two further it passed a steam saw-mill, and the next moment brought into view the group of wooden buildings of the Forest Academy, that were first seen across a beautiful lake. As our arrival was expected no time was lost in explanations, and the most generous hospitality awaited us.

'The two days spent at this place were most profitably employed, and although in vacation, every care was taken to illustrate the working of the establishment, including the mill, in which steam was got up to show its operations. There are two separate branches of instruction taught here, one for the education of forest agents, and the other of forest guards. The number of students is small, but the course appeared well arranged, and the results very satisfactory. Mr B. is a Swede, and received his professional training at the Saxon School of Forestry in Tharand.

'In wandering through the forests we noticed that the timber was small, and of slow growth. It was chiefly fir, pine, birch, and poplar, and was not comparable in size or density with our common native forest growth. Experiments had been made with the Siberian larch, but the plantation was too young to judge of the result. Some years before we had sent to this place several pounds of seeds of our white pine, and small parcels of seeds of the

sugar maple, yellow birch, hemlock, arbor vitæ, and black cherry. They had come up, and for a time promised to succeed; but a frost one night in mid-summer the year before had killed everything to the ground.

'Forest products form more than half in value of the exports of Finland, and until recently no efforts have been made to restrain their waste. This destruction appears in their extensive lumbering operations—in the vicious habit of burning over the surface which prevails—the cutting of timber for making tar, and the use of wood for fencing to needless extent. It was found by recent estimate that 754 millions of cubic feet are used every year for fences, a large part of which might be saved. At lat. 61° 30′ the forests are estimated as growing wood to a size for carpenters' use in 60 years in the best soils, and in 90 to 100 years in less fertile places; for sawing it must grow 100 to 120 years; and at 64°, which is about the average latitude of Finland, 20 years must be added to these figures. In the northern part they must wait from 120 to 180 years for wood suitable for framing, and from 180 to 230 years for wood large enough for saw logs.

'The Crown forests occupy 131,500 square kilometers (81,711 sq. miles), but by far the greater part of this lies in the northern provinces. About four millions of logs are sawn every year, of which three-fourths are from private lands. At the end of 1875 there were 148 State saw mills in the country run by water, and 61 by steam, not including those for merely local use.

'Seldom has the parting word been spoken with more sincere regret than on the morning when we left Evois. Although our personal acquaintance had been brief, we had long corresponded, having been brought together in an epistolary way through the agency of the late Hon. George P. Marsh. Mr B. accompanied us to his frontier at the gate, and as he gave the parting hand he said: "We shall never meet on earth again—may we meet in heaven!" Returning by the way we came to Tavastehus, after returning thanks to the Governor, and rewarding the

coachman, in the manner that had been advised as proper, we took the first train for St. Petersburg, and arrived there on the morning of August 15th.'*

Besides the instruction in forest science given in the Forest Institute, and in the School for Forest Guards at Evois, there is also instruction in forestry given in the Institute of Agriculture at Mustiala, where Mr A. L. Borenius is professor of this science. He is known as a distinguished forester and writer on forestry in Finnish and in German journals.

In the Polytechnic School in Helsingfors, there is also a short course of instruction in forest science given; and in the agricultural schools for the rural population, elementary instruction in sylviculture is given.

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* To any student of Forestry desirous of visiting Evois the following information may be acceptable. From Rilhimski, a station on the railway between St. Petersburg and Helsingfors, a branch line goes to Tavastehus. Thence a journey of some fifty versts (or thirty-three miles) by chaise—the one-horse conveyance of the country—will take the traveller to Evois. The journey will occupy about six hours. It leads through the post stations of Heinökangar, Syrjäntaka. Yso-Eve, and Evon Opista. The charge is ten penni per verst, or one mark, equal to tenpence sterling, per Finnish mile of ten versts, or between six and seven miles English. At the hotel (Hôtel Nordin) every assistance will be courteously given to the traveller.—J. C. B.

CHAPTER VIII.

FORESTS AND FOREST TREES.

'THE extent of forests in the Grand Duchy of Finland,' writes Dr. Blomqvist, Director of the School of Forestry at Evois, 'has been calculated at about 3,000 square geographical miles, which is about 56 per cent. of the entire surface of the country. About 2,559 square miles of these forests belong to the State, of which 90 per cent. are situated in the government of Uleaborg, which comprises half of the area of the country, and is situated to the north of 64° lat.

'The situation of Finland, between 59° 48′ and 70° 60′ lat., occasions naturally considerable differences in the forest vegetation, both in regard to the species and the development of the trees. On the other hand, the difference of altitude is not so great as to cause very remarkable differences in this vegetation. Finland is not a plain; it presents, on the contrary, a very varied aspect of lands, both high and low. Still, the elevation above the level of the sea is by no means considerable: the greater part scarcely reaches an altitude of 130 metres. In the interior the lands which separate the water systems rise to about 200 metres; in the north-east, as in Lapland, the altitude amounts to 300 metres, only some isolated mountains in Lapland rise to an altitude of from 600 to 900 metres.

'The greater part of the wooded soil of Finland consists of sandy earth, coming from glacial and diluvial formations, and it is found in beds of considerable depth. These lands are, for the greater part, more or less stony, and they present a great variety both in regard to their physical condition and in regard to the composition of their mineral constituents. The fertility of this sandy soil depends

principally upon its consistence and its moisture, which varies much, and is affected considerably by the quality of the layers of humus. These are exposed to accidental changes, occasioned by the forest fires which are so frequent in Finland. In the lands which have been long exposed to the sunshine, or devastated by fires, they rarely have a depth exceeding five millemetres; in lands well conserved they vary in depth from three centimetres to one decimeter or more.'

Section A.—Conifers.

In statistical notes by Dr K. E. F. Ignatius, Director of the Bureau of Statistics, published in 1876, it is stated: 'Apart from the cultivated plants, and, perhaps, even without excepting these, the principal wealth of Finland consists of her forests.

'Amongst the different kinds of trees of which these forests are composed may be reckoned the following:

'The pine (*Pinus sylvestris*), the tree by far the most extensively diffused and the most productive. It is found throughout the whole country, except the extreme north, where it ceases to make its appearance, at one part in the neighbourhood of Kelottijarvi (68° 30′), at another part a little to the north of the lake Enare (69° 30′), while along water courses it may be traced still further north to the confluence of the Utsjoki and the Tana (69° 55′), but there it is very stunted.

The tree, it may be mentioned, is called in Finnish, *Mantzpetaja Honka;* in Russ, *Sosna;* in Swedish *Tall Fur* or *Fura;* in Norwegian and Danish, *Fure;* in German, *Kiefer, Föhre, Forche, Forle, Fuhre;* in Dutch, *Pijnboom;* in French, *Pin Sylvestre;* in Italian, *Pino, Pino comune, Pino sylvestre;* in Spanish, *Pinô;* in Portuguese, *Pinheiro;* in English, *Scots Fir.*

At the National Exhibition held in Moscow in 1882

there were exhibited eight transverse sections of trunks of the *Pinus silvestris*, which I have tabulated thus :—

Place of Growth.	Latitude.	Age of Tree. Years.	Height. Finnish Feet.	Diameter. Inches.
Evois, - - - - -	61° 15′	216	87	21
Orihvesi, - - - -	61° 40′	200	87	19·2
Ruovesi, - - - -	62°	305	92	21·7
Kemi, - - - - -	66° 15′	365	79	20·2
Tornea, - - - -	66° 40′	176	40	15
Ravaniemi, - - - -	66° 47′	198	72	13
Do., - - - -	66° 49′	337	91	19
Muonioniska, - - -	67° 68′	365	61	20*

Of the *Pinus silvestris* it is reported by Dr Blomqvist that it is not only the tree most extensively spread over Finland, but it is also the one most valuable in an economical point of view. It constitutes the most important article of exportation, and is employed in the most varied applications—shipbuilding and house building, the fabrication of machines, and of utensils of every description.

* In regard to these details, and others which will be given in regard to other kinds of trees, it may be mentioned that no attention was given to select trees of special size; that the Finnish measurement employed is that of the foot of ten decimal inches, equal to 0·2969 metres; that the transverse sections were made at heights ranging from three to five feet from the ground; and that the diameter reported was measured while the tree was yet green, and no allowance was made for shrinking, which may have since occurred. At the same place, at the same time, there was exhibited a round table, formed of polished wood of the principal kinds of trees growing wild in Finland. In the centre was a transverse section of the *Pinus silvestris*, 216 years of age, mentioned as having been supplied from Evois. An exterior band of blackwood was made of bog wood taken from an oak trunk found in Lake Björnsjön, of which mention will afterwards be made, and in intermediate bands were arranged in succession polished specimens of wood yielded by the following kinds of indigenous trees :—

1. Prunus padus L.
2. Betula alba L.
3. Pyrus malus L.
4. Acer Platanoides L.
5. Pyrus communis L.
6. Betula alba L.
7. Alnus incana Willd.
8. Populus tremula L.
9. Aesculus hippocastanum L.
10. Betula alba L.
11. Salix caprea L.
12. Pinus abies L.
13. Pinus silvestris L.
14. Juniperus communis L.
15. Larix sibirica Led.
16. Quercus pedunculata Ehrh.
17. Ulmus montana L.
18. Fraxinus excelsior L.
19. Sorbus aucuparia L.

It is also used for lighting and for heating, and employed for the fabrication of charcoal, of turpentine, of resin, of pitch, of tar, and of lamp-black.

His report is that in the western parts of Finland we find forests of *Pinus silvestris* up to 68° 30′ lat., but in the eastern parts up to 69° 30′. Further to the north it grows only in sheltered places, but in such situations it is found in forests so far north as 69° 55′, but only in a dwarf state, and intermixed with birch trees.

The fir (*Abies excelsor*) is also very common, and forms vast forests to the south of the Arctic Circle. The northern boundary of its growth is marked by a line which, a little to the north of the Ounastunturi (68° 20′), extends to the village of Kyroe (68° 45′), not far from the embouchure of the Ivalojoki in the lake Enare. But isolated trees of it are found in the Lappish territory of Enare in latitude 69°.

Of this, known as the Norway spruce, there were exhibited at Moscow four sections of trunks, grown in Finland, which may be thus tabulated:—

Place of Growth.	Latitude.	Age. Years.	Height. Finnish Feet.	Diameter. Inches.
Evois,	61° 15′	195	115	22
Vütasaari,	63° 15′	177	102	18·2
Torneä,	66° 30′	194	75	21.6
Rovaniemi,	66° 35′	163	85	15·5

In regard to this, the *Pinus abies* L., *Abies excelsor* D.C., it is reported by Dr Blomqvist:—'We have two varieties of the Norway pine, one of which has in the cone rhomboidal scales denticulated at the apex, and the other obovate scales entire at the apex. The former may be considered as the principal form, and identical with the Norway pine of Central Europe. The second (var. *Medioxima Nylander*

should be considered rather as a variety forming a transition to the *Picea obovata* Ledebour, of Russia. Moreover, we meet in Finland with a whole series of transitional forms between the two forms named. If these two forms do present some differences of growth, of wood, of habitat, or other qualities of importance in a forestal point of view, it is not yet known to be the case; and the area of their respective homes has not yet been sufficiently observed. The principal form prevails almost everywhere throughout the country; in the south the variety with obovate scales is only met with here and there; towards the north it becomes less rare, and on the north-east frontier it is even dominating. The northern limits of forests of Norfolk pine occurs at 68° 15′ on the western frontier, and at 68° 45′ on the eastern. Further to the north, it no more forms forests, but we meet with solitary and stunted specimens up to 69° in the Lapland territory of Enari. It must also be stated that in Norway, at *Svanevigen* (69° 30′) on the frontiers of Russia, Forest-Master J. C. Barth found a clump of Norway pine, ascertained to be of obovate variety.

'Amongst the different kinds of trees indigenous to Finland the Norway pine holds the second rank, both as to extent of growth and in economic importance.'

In 1788 a Kron-park in the parish of *Ny Kyrka* (*Newkirk*) 60° 20′, in the Government of Wyborg, situated about five versts from the railway station at Raivola, between Wyborg and St. Petersburg, was, at the instance of the Admiralty, planted with Siberian larch (*Larix sibirica* Led.) This tree is not indigenous in Finland, but the trees planted there have maintained their footing. At Moscow there were exhibited two sections of trees grown there, one of a height of 110 feet, and a diameter of 10 inches; the other of a height of 112 feet, and a diameter of 11·5 inches.

Dr Blomqvist reports of the Siberian larch that, though not indigenous in the country, it has there attained great dimensions. Specimens are to be seen 135 feet in height,

and 2 feet in diameter, about five feet from the ground, with wood of excellent quality. By the students of the School of Forestry the Siberian larch has been of late transplanted into the most differing parts of the country, and has more especially been cultivated at Evois.

The European larch (*L. Europaea* D.C.) has also, though not indigenous, been planted within the last 40 or 50 years, and is found in different places in small forest masses, as, for example, in the woods belonging to the manufactories of Fiskars and others. Transverse sections of trunks, and a slip of wood from Fiskars (60° 8′) were exhibited at Moscow; a section from Svarta in the same latitude (60° 8′) was exhibited, it was of a tree 14 years years in age, 15 feet high, and 5 inches in diameter; and there was exhibited from Evois (61° 15′) of a tree of the same age, 14 years, 16 feet high, and 8·1 inches in diameter.

The juniper (*Juniperus communis* L.) grows everywhere throughout the country, generally as a bush, but sometimes as a small tree. At Moscow was exhibited a section from Evois (61° 15′), of a tree 40 years old, 2·5 inches in diameter, and another from Pällilä (60° 32′), 150 years old, 46 feet high, and 7 inches in diameter, and a slab of the same tree.

The yew (*Taxus baccata* L.) is found in the Aland Islands, but only there, ordinarily as a bush, but sometimes, though more rarely, as a small tree.

Section B.—Broad-Leaved Trees.

In regard to broad-leaved trees indigenous in Finland we learn from the Statistical Notes by Dr Ignatius:—

'The birch (*Betula alba*), of which there are in Finland two varieties very similar to each other, and often confounded—*Betula verrucosa* and *Betula glutinosa*—forms forests of considerable extent, especially on grounds pre-

viously cleared of trees by the burning of forests which had covered them. The *Betula verrucosa* attains to the same northern limits as the fir; but the *Betula glutinosa* is still met with frequently, although stunted, to the extreme north of Finland, which is much beyond this.'

The wavy-leaved alder (*Alnus incana*) is common, excepting in the north; it is found generally mixed with other kinds of trees; but in some districts it forms forests which are pretty extensive.

The other indigenous trees are more met with in groups of such extent as to form woods—the willow (*Salix caprea*), the mountain ash (*Sorbus aucuparia*), the bird cherry (*Prunus padus*), are all pretty common; the small-leaved lime tree (*Tilia parvifolia*), which is met with growing wild up to 63° 40′, the Norway maple (*Acer platanoides*), the elm (*Ulmus campestris*), the ash (*Fraxinus excelsior*), the crab apple (*Pyrus malus*), the Lapland service tree (*Sorbus fennica*), are all met with only in the south of Finland, and are rare even there. The shrubs and bushes are not very numerous; amongst others there are these, the juniper (*Juniperus communis*), the yew (*Taxus baccata*), the dwarf birch (*Betula nana*), the osier (*Salix*), of which there are found in Finland some twenty varieties; the hazel (*Corylus avellana*), which is found so far north as 61° 40′; the guelder rose (*Viburnum opulus*), the berry-bearing buckthorn (*Rhamnus frangula*), the fly lonicera (*L. Xylosteum*), the Alpine currant (*Ribes alpinum*) the raspberry (*Rubus idaeus*), the black currant (*Ribes nigrum*); all which extend so far north as 67° 20′; and the gooseberry, which grows luxuriantly, to the northern extremity of Finland.

Besides the indigenous trees and bushes which we have mentioned there are found in Finland a great many others which have been brought from other countries and acclimatised. The following kinds of trees are found interspersed among others, but they rarely constitute

forests by themselves, and then only to an inconsiderable extent.

The aspen (*Populus tremula*), rare in the extreme north, is everywhere else pretty common. The common alder (*Alnus glutinosa*) is met with in the south up to 64° lat. The oak (*Quercus pedunculata* Ehrh.) is only found in the south along the coast of the Gulf of Finland; and it forms but rarely woods, and these but small, as at Runsala, near Abo. It does not grow wild beyond 60 °35′, but cultivated it is met with to the north of this, as for example at Wöro 63° lat. The cracking willow (*Salix fragilis*), the lilac (*Syringa vulgaris*), the Siberian pea-tree (*Caragena arborescens*), the honeysuckle (*Honicera caprifolium*), the Tartarian honeysuckle (*H. Tartarica* Lin.), the Tacamahac (*Populus balsamifera*), and the horse chestnut (*Aesculus hippocastaneum*), &c.

In regard to the birch it is reported by Dr. Blomqvist that the white birch (*Betula verrucosa* Ehr.), and the pubescent birch (*B. glutinosa* Waller), growing in Finland, are often confounded. In the western part of the country the white birch is met with up to 68° 15′, in the eastern part of the country it is found to 66° 25′. The pubescent birch grows throughout the whole country, extending beyond its northern limits, and in the extreme north of Lapland it is this tree alone which constitutes the forests found there.

In an economical point of view the birches are, after the Scots fir and the Norway pine, the kinds of trees of most importance in Finland. They supply the best firewood, and the wood yielded by them, which is close-grained and tenaceous, is made use of in the fabrication of machines, tools, utensils, &c. The variegated wood is especially sought after. The exterior layers of the bark are made use of in a variety of ways, and in some parts of the country they constitute an article of commerce.

There were exhibited at the National Exhibition in Moscow, in 1882, several articles made by a boy of 11 years of age in Finland, to show what is done extensively by the

people of the Grand Duchy. There were baskets, or a sort of bag, for carrying provisions on a journey, or that of workmen in the open air at a distance from their homes, and others for holding provisions of different kinds in the house; sheaths for bottles requiring protection in transport, boxes of different kinds, toys for children, and shoes. To other like uses I have seen in the northern forests of Russia this bark applied.

Of the white birch (*Betula alba* L.) there were exhibited at Moscow four sections of trunks, one from Evois (61° 15′), and another from Vütasaari (63°), of neither of which were details given; the third from Torneä (lat. 66° 35′) was of a tree 70 years of age, 24 feet in height, and 7·5 inches in diameter; and the fourth from Munio (68° 70′) was of a tree 87 years of age, 42 feet in height, and 7·5 inches in diameter.

The smooth dwarf birch (*B. nana*) is found throughout the country, and is more especially common in the north. It is a small shrub or bush.

The hoary-leaved alder (*Alnus incana* Willd.) is also found everywhere. It is very common up to the neighbourhood of 65°; further to the north it only grows on the margins of lakes and rivers. It forms considerable forest masses in the districts in which the land is cultivated by *Svedjande* or *Sartage*.

The common alder (*A. glutinosa* Willd.) is found up to 64°; on the west coast it is found even to 65°, but there it is only a shrub, and very rare. It likes water, and it is often seen lining the margins of lakes.

The aspen (*Populus tremula* L.) is found everywhere; and it is pretty common excepting in the far north, where it becomes rare. Of the aspen there were exhibited at Moscow transverse sections from Fiskars, 60° 8′; from Evois, 60° 15′, the age of the tree 37 years, the diameter 5 inches; and from Pällilä, 60° 32′, 18 inches in diameter.

Amongst the species of willow which grow spontaneously in Finland, the seven following are those most deserving of notice in a forestal point of view :—

1. The great round-leaved willow (*Salix caprea* L.), an arborescent shrub or tree.

2. The grey willow (*S. cinerea* L.), a shrub ; sometimes a bush.

3. The eared willow (*S. aurita* L.), a shrub.

4. The dark broad-leaved willow (*S. nigricans* Sm.), a shrub.

5. The tea-leaved willow (*S. phylicifolia* L.), a shrub.

6. The bay-leaved willow (*S. pentandra* L.), a shrub ; sometimes a bush.

7. The cracking willow (*S. fragilis* L.), most frequently a tree.

With the exception of the last they are spread throughout almost the whole country. Their bark is used chiefly for tanning, and it is exported in considerable quantities into Russia, especially from the south-eastern part of Finland. *S. fragilis* is generally planted even to the north of Finland ; but it is also met with growing wild in the southern part of the country, where, however, it is not indigenous, but has been introduced by cultivation.

There are found in Finland besides these, exclusive of varieties and hybrid forms, the following species, of which several grow only in small clumps in Lapland :—

The almond-leaved willow (*S. amygdalina* L.)
The sharp-leaved willow (*S. acutifolia* L. Willd.)
The Lapland willow (*S. Lapponum* L.)
The glauceus willow (*S. glauca* L.)
The woolly willow (*S. lanata* L.)
The stunted willow (*S. depressa* L.—*S. vagands.*)
The creeping willow (*S. repens* L.)
The rosemary-leaved willow (*S. rosmarinifolia* L.)
The myrtle-leaved willow (*S. myrtilloides* L.)
The halbert-leaved willow (*S. hastata* L.)
The whortle-leaved willow (*S. myrsinites* L.)
The little tree willow (*S. arbuscula* L.)
The Polar willow (*S. polaris* Wg.)

The least willow (*S. herbacea* L.)
The wrinkled willow (*S. recticulata*)
At Moscow were exhibited two transverse sections of the great round-leaved willow (*S. caprea*), one from Fiskars, 60° 8′, the other from Torneä, 66° 35′, the latter of a tree 60 years old, 18 feet high, and 4 inches in diameter; also transverse sections and slabs of the bay-leaved willow (*S. pentandra*), and of the grey willow (*S. cinerea*), both from Fiskars, and sections and slabs of the following cultivated trees from the same place: the sharp-leaved willow (*S. acutifolia*, *S. buxifolia*), and the common osier (*S. viminalis* L).

The common oak (*Quercus pedunculata* Ehrh.) grows in the south of Finland to the neighbourhood of 60° 30′, principally upon the coast, where it even forms, exceptionally, small forest masses. Diffused by cultivation, it is met with growing wild, but very rarely, up to 61° 35′, and near to the sea, still further to the north, as far north as Wasa. To the north of Abo is a forest, if my memory serves me right, of oak, about 80 miles in length, but I have some misgivings in regard to the kind of tree.

At the Moscow Exhibition were two specimens of bog-wood, both of them oak, found, the one at the bottom of Lake Björnsjön (the Lake of the Bears), the other in a marsh called Ekhammar (Auckland or Oakland?), both in the lands of Fiskars, and found both of them by Mr E. de Julin, proprietor of the works at Fiskars. The first-mentioned, there can be no doubt, had grown on the dry bank of the lake, whence it had fallen into the water. The head and upper part of the tree are in a state of good preservation, but the lower portion, which rested on the shore, had to a great extent rotted. Judging from the *débris* of oak wood found to the present day in the ground, and the accounts of such discoveries made in times past, it appears very probable that the south-west and north-east shores of the lake were in times remote from ours covered with large oak trees.

The other was found by Mr de Julin in 1877, when digging a canal in the same marsh. It is evident that the tree had not grown on the site of the marsh, which, at the remote period in which it grew, must have been covered with firs, but on the firm soil of a small hillock conterminous with the marsh. The position in which the trunk was found indicates this with much appearance of truth, for it was at a depth of four feet under the level of the marsh, and viewed in connection with the extremely slow growth of like layers of turf, it may be accepted, says Dr Blomqvist, that perhaps thousands of years have passed since the trunk, which must have been of great size, fell there.

In view of what has been made of the fact of trunks of oak having been found in like bogs in Denmark, and the hypothesis which has been raised relative to a succession of different kinds of forest trees having grown upon the same land, something may yet be done towards determining what kinds of trees constituted forests in Finland in prehistoric times, and much besides this concerning them.

The Wych elm (*Ulmus montana* Sm.) in the west of Finland, disappears between 61° and 62°; in the eastern portion of the country it is found a little beyond 62°.

The spreading-flowered elm (*U. effusa* Willd.) extends in the west to like limits with those of the Wych elm; but in the east it is not found beyond 61°.

The Norway maple (*Acer platanoides* L.) extends to the vicinity of 62°.

The common ash (*Fraxinus excelsior* L.) grows in the south of Finland to beyond 61°.

The small-leaved lime tree (*Tilia parvifolia* Ehr.) extends to the vicinity of 63° 40′. The liber is used for making cords &c. On this account the young trees are chiefly in demand, and consequently few attain to great age.

The berry-bearing buckthorn (*Rhamnus frangula* L.) extends to the neighbourhood of the Polar Circle. It is

generally found as an arborescent shrub, but sometimes as a bush.

The purging buckthorn (*R. cathartica* L.) grows only in the south-west part of the country in the neighbourhood of 60°.

The sea buckthorn (*Hippophae rhamoides* L.) grows upon the west coast to beyond 67 .

The mezereon (*Daphne mezereum* L.) grows also as a small shrub to beyond 67°.

The crab apple (*Pyrus malis* L.) is found growing wild in the vicinage of 62° as a small tree, at times as a shrub.

The hawthorn grows as a shrub in the Alland Islands.

The mountain ash (*P. aucuparia* E.B.) grows throughout the whole country.

The bastard service tree (*P. pinnatifida* E.B.) [?] *Sorbus hybrida* L.) in found in the south-western parts of the country, especially in the Alland Islands; while another species (*Sorbus scandica* Fr.) is found, but only rarely in the south-west about 60°.

The dwarf cotoneaster (*C. Vulgaris* Lindl.) is found here and there in the south-west, south, and east, to below 62°. Further to the north it is only met with in the vicinity of the Polar Circle on the frontier of Russia.

The bird cherry (*Prunus Padus* L.) is found throughout the country. The sloe (*P. spinosa* L.) is found in the Alland Islands, but it is rare. The cherry (*P. cerasus* L.) is ordinarily cultivated, but it is found, though rarely, growing wild in the extreme south.

Of berries there is the gooseberry (*Ribes grossularia* L.) cultivated, but sometimes, though rarely, growing wild in the south; the red currant (*R. rubrum*) growing throughout the country; the black currant (*R. nigrum* L.) growing to the vicinage of 67° 30′; and the mountain currant (*R. alpinum*) growing to beyond 64°.

Of roses there are found in Finland the cinnamon rose (*Rosa cinnamomea* L.); the Finnish rose (*R. carelica* Fr.); the dog rose (*R. canina* L.); and the apple-bearing rose (*R. villosa* L.)

Of brambles there are the raspberry (*Rubus idæus* L.); the dewberry (*R. caesius* L.); the suberect blackberry (*R. suberectus* Anders.)

The guelder rose (*Viburnum opulus* L.) is found to between 65° and 66°.

The fly honey suckle (*Lonicera xylosteum* L.) grows to beyond 64°; the blue-berried honey suckle (*L. coerulea* L.) grows only in the extreme north-west parts of the country.

Transverse sections of the wood of most of these species of trees, shrubs, and bushes, all of them indigenous in Finland, were exhibited at Moscow.

Section C.—Forests.

Dr A. Blomqvist, Director of the School of Forestry, to whom I am indebted for these details, states further:—'The forests of Finland are formed of the Scottish fir, Norway fir, of the pubescent birch, the white birch, and of the white alder, either exclusively or reversed; but the broad-leaved trees are almost always intermixed with Scottish fir and Norway pine. These, on the contrary, form each by itself forests of very considerable extent. The forests of Scottish fir occupy the greater extent. Next to these are the forests of Norway pine. The birches and white alder cover also considerable stretches of country. The common alder and the aspen are met with also in smaller woods, but none of these species constitute what can properly be called forests. The aspen, and likewise the mountain ash, the bird cherry, and several species of willow grow dispersed in the forest, and are common throughout the whole country. The small-leaved willow, the Norway maple, the ash, and the oak, more rarely than the species previously mentioned, are to be found dispersed over the areas of their growth.'

By Professor Blomqvist I was informed that there is a good description of the forests in Finland in the *Jahrbuch der Königl sächs Akademie für Forst und Landwirthe zu Tharand. Dreizenter Band (neue Folge Sechster Band.)*

Leipzig, Aroldische Buchhandlang, 1859; by Oberforstrath von Berg, who reported to the Government on the subject the year before: the Government having desired the opinion of a German authority before committing themselves to the new organisation of forest administration.

CHAPTER IX.

DISPOSAL OF FOREST PRODUCTS.

Section A.—Timber Exports.

Dr. Ignatius in his Statistical Notes, published in connection with the International Exhibition in Paris in 1878, states 'that the forest products constitute more than half of the entire exports from Finland, according to the money value of these exports. The forest products which constitute the greater portion of such exports consist of sawn timber, boards, planks, laths, &c. It is not many years ago since all the sawing was done by hand in winter by the peasants, who then transported the planks on sledges to the nearest port. Now there are to be found at the mouth of almost all the great rivers, and on many of the watercourses in the interior, large sawmills moved by water or by steam. From remote forests logs bound together, so as to form immense rafts, are floated to these sawmills; and sometimes it happens, that these rafts are years in reaching their destination.' An account of such rafts, of their appearance, and their structure, has been given—ante p. 13—in the narrative of what I saw on my trip on the Saima See.

The supply of timber to these sawmills is procured by private enterprise, but it is anticipated that a change in this particular may take place, seeing that the Government is giving attention to the preparation of the watercourses for the floatage of wood. In 1872 it was calculated that the Crown forests were ready to deliver in the bason of the Kemi about three millions of trunks, and one million of logs or beams; in the bason of the Ulea 700,000 trunks, and one million logs; along the upper

course of the Kemi 600,000 trunks, and almost as many logs; in the bason of the Räijänne 600,000 trunks, and 800,000 logs; and lastly, in the bason of the Saima, 900,000 trunks, and 400,000 logs. The total quantity of timber ready to be cut up, provided by the Crown forests for floatage to the Gulf of Bothnia, was about nine millions of trunks, and 3,300,000 beams or logs, and for floatage to the Gulf of Finland 1,700,000 trunks, and 1,400,000 logs. But the exploitation has been but trifling compared with the great resources thus indicated. In 1873, for example, the Crown forests did not deliver more than about 600,000 logs and trunks.

At the end of 1875 the number of sawmills, including some designed for the supply of local requirements, but these were not many, was as follows in the different governments:—

	Water Power.	Steam.	Total.
Nylands,	23	13	36
Abo and Björneborg,	27	11	38
Tavastehus,	26	8	34
Wyborg,	5	13	18
St. Michael,	15	2	17
Kuopio,	9	2	11
Wasa,	21	5	26
Uleaborg,	22	7	29
Total,	148	61	209

The export of cut wood was—

In 1864,	13,500,000	cubic feet.
In 1865,	20,100,000	,,
In 1870,	15,000,000	,,
In 1872,	23,000,000	,,
In 1873,	26,800,000	,,
In 1874,	32,200,000	,,
In 1875,	30,600,000	,,
In 1876,	40,100,000	,,

The following table supplies an abridged statement of forest products, and the quantities of these exported in the years 1864 to 1870 inclusive:—

	TIMBER AND FIREWOOD.							
	Beams.	Boards.		Laths.	Planks.		Spars.	Firewood.
	Pieces.	Dozens.	Cubic feet.	Dozen.	Dozen.	Cubic feet.	Pieces.	
1864	16,730	292,684	5,095,778	31,235	271,576	8,463,145	50,537	96,343
1865	31,942	470,075	6,078,838	50,614	415,123	14,063,190	120,663	85,969
1866	14,177	411,364	5,168,619	50,689	363,790	11,818,616	94,933	104,274
1867	11,097	387,991	4,712,009	64,403	268,549	9,468,589	88,294	106,142
1868	69,881	541,192	5,407,328	72,570	342,909	11,725,414	174,917	114,672
1869	33,457	610,402	6,079,653	57,533	350,007	11,676,012	133,214	99,848
1870	22,948	784,323	5,530,174	45,650	273,855	9,482,258	86,657	79,649

I have failed to obtain the returns for 1871, 1872, and 1873, but the following tabulated statement of exports of

forest products supplies information in regard to these in the three subsequent years, 1874, 1875, and 1876 :—

	1874.	1875.	1876.
Battens, dozens,	172,303	187,236	251,202
Balks, pieces,	76,262	77,308	49,803
Deals, dozens,	1,071,908	1,146,672	1,568,332
Laths, ,,	47,909	47,263	64,241
Mine Props, pieces,	721,628	37,228	686,625
Planks, dozens,	480,596	395,762	542,907
Logs, pieces,	502,354	88,765	6,542
Rafters, ,,	223,386	218,303	283,284
Poles, ,,	106,160	16,155	35,285
Wood for Carpentry,	214,846	219,028	409,013
Ends of Planks, cubic feet,	500,000	423,000	1,124,280
Telegraph Poles, pieces,	16,980	436	707,419
Wood in various forms, value in marks or francs,	1,349,768	421,345	539,698
Firewood—Birch, fathoms,	65,133	63,894	95,133
,, Fir and Pine, faths.	64,154	67,158	89,175
,, Other Wood, ,,	3,944	7,480	17,291
Shingles, thousands,	13,894	20,271	28,610
Casks, Pipes, &c.,	1,179	3,508	1,464
Handspikes, or Crowbars, &c., pieces,	58,919	93,642	265,088
Tubs, Pails, Buckets, pieces,	1,666	1,732	949
Scoops and Shovels,	6,059	4,441	4,342
Charcoal, hectolitres,	34,217	25,582	60,944
Resin, kilogrammes,	88,876	112,846	146,226
Willow Bark, ,,	3,411,722	3,194,504	3,114,451
Potash, &c., ,,	116,270	84,244	84,787
Tar, hectolitres,	290,088	270,511	277,111
Pitch, ,,	6,150	16,140	7,911
Wood Alcohol,	3,018	26,622	——
Lamp Black, chests,	398,328	175,642	32,706

There may be reckoned also amongst forest products other articles of export, such as berries—the export of red whortle berries alone in 1873 amounted to 22,076 hectolitres ; moss ; basket-work, &c.

Mr Wm. Crighton, British Consul at Abo—who is himself interested at least indirectly in the timber trade, having

been engaged for the last 30 years in the construction of iron ships in Russia and Finland, is a consumer, in so much as forest products are required both for the decks and for cabin fittings—informed me that the principal timber of the country—white and yellow pine—when exported, is exported in the form of deals, boards, planks, and battens. Mining timber and logs are exported in very small quantities, and a little birch is exported in planks, but this wood is generally only fit for consumption as firewood. He wrote to me in reply to some explicit questions :—'I have travelled very little in the interior of the country; I can only say that the export of timber has very much increased of late years, and that a large number of saw-mills have been recently erected, both in the interior and along the coast, the largest of which is at Kothka, a new town situated near the mouth of the Kymmene river, on the coast between Wyborg and Fredrikshamn. The extension of railways in Finland has conduced much to the erection of saw-mills in the interior. For instance, a large saw-mill recently put up at Akkas, a place half-way between Tavastehus and Tammerfors, ships all its produce at Abo, sending it thither by rail. Large quantities of timber are now shipped at Kothka, Sornas, near Helsingfors, Abo, Björneborg, and other northern towns, besides Wyborg and Trangsund, and, notwithstanding the lowness of the price abroad, it is remunerative.'

I have spoken of the extensive saw-mills of Messrs Hood & Co. at Nyslott. Besides these, there were brought under my attention the following :—Those of Messrs Hackman & Co., of Messrs Wahl & Co., of Mr C. Rosenius, all in Wyborg; of Mr Ahlqvist, in Fredrikshamn; of Messrs Gutzest & Co., in Kothka; of Messrs Rosenlew & Co., in Björneborg; and of Mr Cannelin, in Uleaborg.

Section B.—Shipbuilding.

In the classification of forest produce prescribed to the

Forest-Master, special mention is made of wood suitable for shipbuilding. Such is chiefly made use of in the country. It may be the case that to a great extent iron is now used instead of wood in shipbuilding in Finland as elsewhere; but the consumption of wood produced in the country in this industry is far from being inconsiderable. About 70 per cent. of the exports and imports of Finland are made in Finnish vessels. The mercantile navy of Finland in 1876 consisted of about 1900 vessels, of an aggregate tonnage of 150,000 Finnish *lastes*, or 285,000 tons, exclusive of sailing boats of less than 10 *lastes*' tonnage, and of that number 125 were steam vessels of an aggregate tonnage of 3819 *lastes*.

The commerce of Finland has been steadily increasing of late years. The following is the number of vessels and their tonnage, entering and leaving Finland in the years cited:—

	Ships Entering.		Ships Leaving.	
	Number.	Tonnage.	Number.	Tonnage.
1866	3742	516,804	3901	528,523
1871	6313	691,898	7001	712,907
1876	9304	1,314,999	9220	1,310,679

The imports and exports in the same years were, with the duties in marks, equivalent to francs, or tenpence sterling:—

	Imports.	Exports.	Duty.
1866 - -	48,066,339	27,748,686	5,813,984
1871 - -	65,817,834	45,427,401	7,588,060
1876 - -	140,001,210	98,691,376	12,500,000

In the instructions for the management of Crown forests, issued under date of 13th May 1859, [ante p. 119, pp. 132-138], prescriptions were given of the size of wood to which timber required for different purposes should be confined.

In these prescriptions shipbuilding timber is classified thus :—

(*a.*) Mast timber. Pine trunks, of straight growth, free from twist or shake, at least 70 feet long, and 21 *decimal-tinns* or *feults*—one-tenth of a Finnish foot—in diameter at 6 feet above the root, with an upper diameter of $12\frac{4}{5}$ dec., and at the centre of equilibrium, 20 feet or more from the top, a diameter of at least 15 dec.

(*b.*) Large mast spars of pine wood, 68 feet in length, with a diameter of $19\frac{2}{3}$ dec. 6 feet from the root, and a diameter of $12\frac{4}{5}$ at the upper end.

(*c.*) Lesser mast spars of pine, 60 feet long, with diameter 6 feet from the root of 18 dec., and a diameter of $11\frac{1}{10}$ dec. at the upper extremity.

(*d.*) Large yard spars of pine or fir, free from twist, 70 feet long, with a diameter 6 feet from the root of $20\frac{1}{2}$ dec., and a diameter at upper extremity of $10\frac{1}{3}$ dec., with a diameter at half the length of $15\frac{1}{2}$ dec.

(*e.*) Top-gallant mast yards of pine or fir, of the length of 70 feet, with a diameter, at centre of equilibrium, of 12 dec., and of 7 dec. at top.

(*f.*) Bowsprits of pine; the greater 42 feet long, with a diameter at 6 feet above the root of $25\frac{2}{3}$ dec.; the lesser 36 feet long, with a diameter of $22\frac{1}{4}$ dec. 6 feet above the root, and at the top of $15\frac{1}{2}$ dec.

(*g.*) Keel timber of pine or fir, at least 36 feet long, and a diameter of at least 17 dec.

(*h.*) Rudder beams of pine or fir, heart wood, at least 30 feet long, and at least 15 dec. in diameter.

(*i.*) Deck balks of pine: the larger 30 feet long, 7 to $7\frac{2}{3}$ dec. in breadth, and 19 dec. in thickness; the lesser 24 feet long, 4 to $4\frac{1}{4}$ dec. in breadth, and $12\frac{2}{3}$ dec. in thickness.

(*k.*) Kloss timber, the larger 30 feet long, 22 dec. in diameter; the lesser 24 feet long, 19 dec. in thickness.

(*l.*) Bottom sleepers of pine or fir trunks, with root branch at an obtuse angle of 135°, or at a right angle of 90°, of which there are generally required in shipbuilding three times as many of the former—the obtuse angled, as of the latter—the right angled. In dimensions they are classified thus: the larger with a length of trunk of 10 feet, with a root branch 2 feet long, hewn with a breadth of 20½ dec., and a thickness of 10¼ dec.; the lesser with a length of trunk of 8 feet, and a root branch of 1 foot long, a breadth of 12 dec., and a thickness of 7¾ dec.

(*m.*) Knees of firwood, with a strong root branch, whereof can be hewn right-angled pieces, in which the stem portion is double the length of the root portion, and of the following dimensions: large knees, length of stem 13 feet, and of root branch 6 feet, with a transverse diameter of stem 3 feet from the angle of at least 15 dec., and of root branch 1½ feet from the angle of at least 10 dec.; small knees, length of stem 7 feet, of root branch 3½ feet, and of the breadth required in the others.

(*n.*) Keel roots of fir, which are also knees, the root branch forming with the stem an angle of 135°, the length of stem 4 to 6 feet, and the transverse diameter 17 to 21 dec.

From time immemorial the inhabitants of the Finnish coast have been engaged in shipbuilding, and those in the vicinity of Jakobstad, and of Gamla Karlely in particular, have been renowned as excellent ship carpenters and builders. The art of shipbuilding is attracting more and more attention, especially along the south coast, where every year numerous regattas excite interest, and supply demonstration of the advantages of a good model.

I have made mention of the extent to which I found iron steamers employed on Lake Saima. In regard to the general use now made of such vessels throughout Finland, and in other forest lands in the north of Europe; and

the bearing of this upon shipbuilding, I learned from Mr Wm. Crighton, British Consul at Abo, with whom I put myself in communication on the subject before leaving the country, that :—

'Timber shipbuilding is not now in the flourishing condition which it once was; and this is the case because it is becoming more and more difficult to obtain in the country suitable timber, and iron vessels, propelled by steam power or otherwise, are everywhere taking the place of vessels built of wood. But neither can I say, generally speaking, the iron shipbuilding trade is at present flourishing; because we cannot compete on equal terms with such iron-producing countries with engineering advantages as Great Britain and Sweden.

'Labour is much cheaper, but also indifferent. The only exception is perhaps my own establishment, which is conducted more on foreign principles; and, in consequence of old and good connections, is patronised by the Russian Government. Besides this, most of the other engineering and shipbuilding concerns in the country make everything, whilst we only build ships and make engines. Twenty years ago we employed about 150 men, now we employ about 800, and sometimes more.

'The first iron steamer was built in Finland in 1850, and very little was done during the first ten years.

'Just 20 years ago I started here in the concern that bears my name, in company with Mr Julin, one of the chief merchants in this town, and during that time we have built steamers for all parts of Finland and Russia, from 1 to 500 horse-power, and we have at the present moment six large steamers in hand for the Russian Government and private parties.'

Section C.—House-Building and Carpentry.

There is a great consumption of wood in the building of houses in Finland, most of them being built entirely of that material—log laid on log—the extremities of those

composing contiguous sides crossing each other at the corner. I have found it convenient to class together house-building and carpentry, and in this I include cabinet-making, coach-building, and the production of railway sleepers, and construction and repairs of railway carriages and waggons.

Having stated the measurements prescribed by the Instructions issued under date of 13th May, relative to the sizes of wood to be supplied for different applications in shipbuilding, I may, before proceeding further with my narrative, state here what sizes of wood were in these instructions prescribed for different purposes connected with house-building and carpentry. These were classified thus :—

1. Large timber of pine or fir, which can be made into balks and beams fit to be employed in the construction of mills and other great machinery. Trunks not less than 24 feet long, and a diameter at upper end not less than 13½ dec.

2. Logs or saw timber of pine or fir measuring not less than 10 inches at smallest diameter, and of lengths specified thus—large logs not less than 24 feet long, middle sized logs not less than 15 feet, and lesser logs 11½ feet.

3. Building timber of pine or fir :—

(*a.*) Timber with a diameter of at least 7 dec. at upper end, and of the following classes :—large timber, at least 36 feet long; middle-sized timber, 30 feet long; and lesser timber, 24 feet.

(*b.*) Rafters at least 30 feet long, with a bottom diameter of at least 9 dec.

(*c.*) Spars at least 24 feet long, with a bottom diameter of at least 7 dec.

4. Beams and railway sleepers. Resinous pine. Beams 8½ feet long, and 10 dec. in diameter, can be employed as such, even though they may have a twist.

5. Telegraph poles of pine or fir, 5 fathoms long, with an upper diameter of at least 3 dec.

6. Lathwood of pine trunk at least 8 feet long, free

from twist, with a bottom diameter of at least 8 dec. They must be free from twist or shake in the fibre.

7. Rail and fence wood. Under this head may be reckoned such pine and fir trees, of straight and otherwise good-conditioned stems, as are felled in the prosecution of thinning operations, having a bottom diameter of from 3½ to 7 dec. Railwood should have a length of at least 24 feet, and fencewood a length of at least 16 feet.

8. Poles of firwood, the produce of thinning, with a bottom diameter of from 1½ to 3 dec.

9. Hoopwood, &c., brushwood, the produce of thinning young woods.

Besides these are mentioned—

10. Tarwood of fir or pine. As pinewood from 15 to 20 years' growth is cut down in thinning, the wood which is not fit to be used as firewood may be barked, and at befitting times be removed and used in the preparation of tar. All such may be reckoned and designated tarwood.

11. Charcoal and firewood. All the wood which cannot be brought within one or another of the classes named.

Carpentry work for machinery and buildings is executed in part in workshops attached to great establishments, but in part at separate establishments. Mr R. Heimberger, at Helsingfors, has a large mechanical carpentry workshop, in which the motive power is steam. Besides this there are some thirty cabinetmakers' establishments, but these can scarcely be described otherwise than as simple workshops. There were enumerated in 1873 649 carpenters and 171 turners in the country, of whom only 94 carpenters and 43 turners carried on their work in towns.

The people often themselves do the simple carpentry work they require, such as the making of doors, window-frames, lintels, casements, furniture, &c. The population of the East Bothnian portion of the Government of Wasa are famous for their skill in carpentry, as they are for their skill in all manual arts. In the environs of Nystad the manufacture of wooden vessels, such as tubs, pails,

buckets, &c., has been for many ages a work of domestic industry, the products of which are exported to Denmark and Northern Germany. Little is done in ornamental woodwork as yet; and the same may be said of children's toys. German and Russian toys are what are generally met with in shops.

There were in this year 11 coachbuilders' establishments, but much is done also in workshops, and in the country many people make their own waggons and sledges, and in some localities, as, for example, at Uskela, they make them for sale. The two-wheeled and four-wheeled vehicles made at Abo have great repute.

The railways of the country must consume a great deal of timber in the construction of sleepers, stations, waggons, and in the repairs from time to time required. In 1878 the railways in Finland measured in extent 820 versts, or 547 miles.

In connection with this reference may be made to the consumption of wood in fences, reported by Dr Heugh as amounting to 754 millions of cubic feet in a year.

Section D.—Industries in which Wood is Made Use of.

The manufacture of matches is a new industry to find a place amongst trades carried on on an extensive scale. Formerly, in Scotland at least, it used to be a handicraft practised by beggar women and old men, successors of the 'gaberlunzie' beggars of a previous age, and it was followed very much as a cover for begging. There are now match manufactories in many of the towns of Finland. The oldest of these is the match manufactory of Sofiegarten, near Björneborg, which, some twenty years ago [1863], was one of the largest establishments of the kind in Europe, and, according to Finnish report, the most renowned both for the quality and the quantity of its

products. The Björneborg matches were formerly exported in great quantities to all countries. Previous to 1875 the manufacture had become greatly reduced. In that year there were produced 15,978 cases of 1000 boxes each of matches of all kinds, valued at 261,700 marks. The establishment gave employment to 30 men, 170 women, and 60 children under 15 years of age. The six other match manufactories then carried on—two at Tammerfors, one at Nystad, one at Jakobstad, one at Helsingfors, and one in the parish of Kupio—were on a smaller scale. These manufactories amply supplied the requirements of the country, and furnished yearly a certain quantity of products, but this has been gradually reduced. The exportations were :—

1870,	40,167	cases.
1871,	9,541	,,
1872,	13,156	,,
1873,	12,057	,,
1874,	5,550	,,
1875,	7,614	,,

The value of the matches manufactured in 1873, according to the official report of the Directory of Manufactures, was 278,505 marks.

Another industry largely employing forest products is tanning. There are in Finland 28 large tanneries; and and there are 200 master tanners in the towns, and 372 in the rural communes. The largest of these is that of Aström Brothers, at Uleaborg, where are manufactured both coarse leather and so-called Russian leather. The total value of the produce in 1875 amounted to 620,000 marks. Of the hides 10,000 were American, and 1800 Finnish. In this year there were imported 700,091 kilogrammes of raw hides.

In Finland there is a large and progressingly increasing manufactory of paper and pasteboard, which is largely exported. This manufacture has received a great impetus

of late years from the extensive preparation of paper pulp from wood.

In the course of conversation with the gentlemen of whom I have spoken in my account of my voyage on Lake Saima mention was made of the manufacture of paper pulp from wood, and when one of them was speaking of the immense quantity of wood *débris* and sawdust with which he was encumbered in his operations I jestingly said 'Why not convert it into wood pulp?' His prompt reply was 'Solely because we cannot do everything at once.'

By Hofrath A. Grippenberg, proprietor of the paper and paper pulp manufactory of Kymmene and Ingerois, I was informed the first Ingerois manufactory was built in 1873. All kinds of paper were manufactured there, but their speciality was paper to be used in the making of cigarettes; what pulp they made was for use in the work chiefly, and very little for exportation. In making printing paper they used 75 per cent. of wood pulp, with 25 per cent. of rags.

On the 1st June 1881 the mill was burned to the ground, and it was rebuilt for the manufactory of paper pulp and pasteboard only. The new mill was completed by December. 16 turbines, with 800 horse-power, supply the needed force. They use only firwood. They have forests of their own, but they purchase also a good deal of wood from others.

The wood is cut into equal sized pieces, which are put into what are called *defibreurs*, in which the fibres are torn apart. In connection with it is a round stone kept in rapid movement; and a great deal of water being employed small pieces of wood are washed along with the torn fibres. All goes then to the sorting apparatus, through which only very fine pulp passes, and the remainder is pumped to another stone, by which it is further disentegrated, and it is floated down, suspended in a great quantity of water. It is then taken up by an endless band, and brought to a room with a very high

temperature. They make about eight tons a-day (400 poods), and they export nearly all to Russia, but they find it rather difficult to dispose of all they can manufacture. They get 2 roubles 50 kopeks for wood pasteboard, and 1 rouble 90 kopeks for wood pulp. In South Russia rags are still so cheap that paper manufacturers do not find it economical to make use of wood pulp. There is also a good deal of wood pulp imported into Russia from Sweden.

Besides the wood made use of in architecture, carpentry, shipbuilding, match-making, and tanning, there is much consumed in the preparation of charcoal, of potash, of alcohol, of resin, pitch, and tar. There has been given —[ante p. 193]—a statement of the quantities of these materials exported in the years 1874–1876.

Tar is manufactured chiefly in Easter Bothnia, but it is also manufactured in all parts of the country. The manufacture of it is an industry of the people. It is carried on thus. In spring they remove the bark from the trunks of pines which have attained to the age of from forty to eighty years, at the height of about seven feet; but on the north side they leave a strip of bark about an inch in breadth, to prevent the drying up of the tree. After three or four years they renew this cutting away of the bark, but at a greater height, about 10 or 14 feet from the ground. The result of this removal of the bark is that the portions of the trunk so stripped become impregnated with resin, and thus supply a suitable material for the manufacture of tar. From six to twelve years after the first removal of bark, they fell the trees, and the stripped portions are employed in the preparation of the tar, which is done in pits. They obtain two hectolitres from ten stères, or cubic mètres, of barked wood. It is calculated that tar is made every year in from 4000 to 5000 pits in different parts of the country, but the greater portion in the provinces of East Bothnia.

A model of the pit used there was exhibited at the

National Exhibition in Moscow this summer. I may add that in many parts of the country they manufacture tar from the stumps and roots of the Scots fir, *Pinus silvestris*. At the same exhibition were exhibited two models of charcoal pits.

Section E.—Fuel.

To the quantity of wood made use of in the manufactures which have been spoken of has to be added the quantity consumed as fuel in other industries, prominent amongst which are tile works, porcelain and glass manufactories, smelting and engineering works, cotton mills, and woollen manufactories, in which steam-power is employed, and locomotive engines in steamboats and on railways, in all of which wood is the principal fuel consumed.

In these it is mainly for the production of motive power that forest products are required. In the production of this there were employed 2357 water wheels, and 211 turbines, of an aggregate of 41,105 horse-power, and 456 steam-engines, of an aggregate of 5429 horse-power. But to these have to be added 93 locomotive railway engines, of 16,400 horse-power, and 211 steamboats of 5407 horse-power. In many of the steam-engine furnaces wood is used as fuel, though coke and coal are largely employed.

To the consumption of firewood as fuel which is thus occasioned, has to be added that of the consumption of wood as fuel in domestic life, in heating the houses, in cooking, and in the baths. The domestic consumption of firewood by a population numbering two millions, living in a country so far north as Finland, and where this is the only fuel accessible to the people, must be very great.

Dr. Ignatius reports that, according to an approximate calculation, there is consumed annually in Finland 754 millions of cubic feet of wood, without taking into account what is consumed in the towns and what is exported. He states that the destruction which is thus occasioned has

been somewhat reduced since the improvement of roads, and a more active speculation thus induced has given to wood a pecuniary value which it had not before; but on the other hand the more active speculation has also had an injurious effect in so far that many proprietors, induced by the high prices given, have sold their forests to the possessors of saw-mills, and these considered it profitable to clear them off, root and branch.

Section F.—Summary.

In the annual reports of the Forest Administration full and explicit information is given in regard to all that has been done under the direction of the Administration in the course of the year in the several inspection districts of the Grand Duchy. I had occasion to study that for 1871. From this it appeared that there were at the close of that year :—*

29,781,066·25 tunnland of forest land; and
16,396 19-60 days' work of labour spent on them.

The expenditure had been—

27,181 mk. 57 p. for days' wages.
350,144 mk. 75 p. for deductions and diverse charges.

In all, 377,326 mk. 32 p.

The delivery of forest products, &c., had been—

182,879 pieces sawn timber.
135,765 pieces sawn timber in beams.
14,339 pieces house timber and planks.
3,298 pieces damaged by wind-shake and decay.
72 pieces dry wood, and

* The following are the measurements in use in Finland, frequently quoted in notices of forest economy :—A Finnish tunnland measures 56,000 square feet, and is equal to 0·45 Russian decatin, 0·49 French hectore, and 1·22 English acre. In a geographical square mile are 11·115 Finnish tunnland. A Finnish foot is equal to 0·2969 French metre, which is divided into 10 inches or *decimaltinns*. A Normal fathom or Normal klafter is equal to 100 cubic feet of closely-packed wood.

289·58 cubic fathoms of the same.
322 pieces damaged beams.
4,292 small trees.
3533 37-140 cubic fathoms firewood.
3717 2-5 cubic fathoms tarwood.
525 13-80 normal fathoms cordwood.
134 cubic fathoms cordwood.
50 cubic fathoms, and
201½ normal fathoms charcoal.
3½ normal fathoms poplar wood.
25 cubic fathoms potash wood.
86½ pine tar barrels.
520 trunks of trees for manufacture of such.
7·48 cubic fathoms tar-barrel wood, and
161 pieces of the same.
294 pieces boat and tar-barrel wood.
2,020 pieces small timber.
20 poles.
530 boat-hook handles.
7½ cubic fathoms, and
1,898 pieces fencing.
14,472 hoops and willow twigs.
66 fathoms lathwood.
46½ casks of tar.
1,000 pieces roof shingles.
10 lispunds potash.
100 lap. fir and birch twigs.
2,000 käwir, and
9·9 cubic fathoms of leaves.
8·86 lispund pine seed.
5 pieces building timber.
18¾ lap. reindeer moss.
25¼ cubic feet bark.

Of forest land cleared of wood by fire, - 76·16 tunnland.
Of meadows or cultivated land, - - 6,684·57 ,,
Do., do., - - - 1,038·75 lapland.
Of bogland, - - - - - - 571¼ days' labour.

53 tunnland, 13 koppecs corn.
798 ,, 17 ,,
155 ,, 22¾ ,, rye.

Money value of products, - - - 365,409 mk. 39 p.
Which was short of expenditure, - - 11,916 mk. 93 p.

In the body of the report it is stated what upon an average of years had been the annual consumption of wood in the country, that from this might be calculated the requirements of the population. The consumption for different purposes was found to be, in fathoms of 100 cubic feet:—

For every House Chimney. Fathoms.	For Chimneys of Manufactories, &c. Fathoms.	
40	12	In Abo and Björnborg, with Nylands and the southern part of Wyborg län.
50	15	In northern part of Wyborg, Tavastehus, with Wasa län, exclusive of the county of Lankos.
60	18	In Lankos, Kuopio län, with Uleäborg län, exclusive of the counties of Kemi and Lappmarken.
70	21	In Kemi and Lappmarken.

To this report was appended a tabulated statement of the extent of arable ground, of forest land, of moorland and sand hills, of mountain country, of bog land, of lakes and water-courses, and of unsurveyed land, in every län or district, and in every county or lesser division of each county, from which the Commissioners show that there were then in Finland—

4,259,649	tunnland	of arable ground under cultivation, or capable of being cultivated.
31,199,072	,,	of forest land.
12,463,458	,,	of unproductive land.
5,927,169	,,	of lakes and water-courses.
17,174,723	,,	of unsurveyed land.
71,024,371	,,	in all.

CHAPTER X.

PROJECTED LEGISLATION ON FORESTRY.

From the consumption of forest products in Finland, and the commercial demand for these for exportation, there is being made continuously a severe drain upon the forests of the country. Some advantages may be expected to result from the clearing of extensive districts in a land so densely wooded supplying ground for agriculture, and bringing about climatal changes favourable to the enterprise. But withal it has been felt that it would be prudent to secure all the advantages which may be derived from conforming the management of the forests to the ever-advancing Forest Science of the day, and the matter has not ceased to receive the attention of the Government. Within the last ten years three different Forest Committees have been organised. The first gave its report on the 24th of March 1874; the next published its decision on the 14th of June 1879; and finally, in the year 1881, a new Committee on the same question was appointed. These in March last (1883) made their report to the Government. Shortly thereafter there appeared in the *Helsingfors Dagblad* a series of papers on what had been done in this matter, and what it was proposed to do, of which the following is a translation supplied to me by a gentleman to whom I owe much for sending to me from time to time notices of subjects pertaining to forestry appearing in Russian newspapers, and for aid in my work in other ways—the Rev. W. Nicolson, agent of the British and Foreign Bible Society:—

'The first Committee were called together under the influence of a fear prevalent at the time relative to the

destruction of forests. The wood trade was then in a comparatively flourishing condition; and, according to our habit, it was not supposed that various objections might exist against the disposal of an article which was increasing in value. But some became afraid that the supply of wood would be exhausted through an increasing export; and the first Committee was appointed mainly to propose means to be employed to prevent the over exploitation of the forests. The Committee proposed the increase of the State forests by the purchase of forests from private persons; the encouragement of the growth of forests in private lands by loans on easy terms; an export tax on unsawn wood to the same amount with the tax on export which is laid in one form or another on sawn wood of corresponding dimensions; increased duty on timber in small pieces in general, &c.; and they recommended the introduction of a new forest law in place of the existing regulations of 1851.

'The result was an increase in the proposed duties on unsawn timber; while the question of the proposed alteration of the forest laws was submitted to the next Committee. This Committee pressed the proposal as to the increase of the Crown forests; approved the creation of communal forests by purchase, forests owned in common, with compulsory powers on the part of a number of proprietors to compel others to join them; and the imposing of rules upon private proprietors as to the disposal of their own forests in regard to *Svedjande*, and the cutting down of timber, through the removal of which their neighbours might be damaged. With respect to this proposal there was desired an expression of opinion from different official persons and wardens, and that of the Finnish Economical Society; and the Committee which has now concluded its work was commissioned to consider those official expressions of opinion which had been received, and to submit proposals concerning the whole matter after due deliberation on the same.

'The consent of the various legislative orders was

needful for legislation on the subject; but as a multitude of particular points in connection with the case could only be determined by the Government, and carried out administratively, the Committee have divided their suggestions regarding forest legislation into two special proposals: the first one for a forest law, the second a proposal for deciding and letting the public know what would take place in certain cases in consequence of the application of this forest law. Into these two proposals there have not as yet been introduced such alterations or additions as the Committee look upon as necessary, in so far as the existing law has to do with other matters which extend beyond the mere question of forests. But there were deemed necessary certain alterations and additions in connection with three existing codes or prescriptions: Prescription of 9th November 1868, concerning mortgages; Decision of 27th December concerning, among other things, the erection of houses for new occupants; and the Prescription of 19th February concerning *egostychning*. These three matters had therefore to come before the Committee.

'The Forest Committee's proposal for a new Forest law, with a view to replacing the administrative arrangements of the year 1857, is divided into chapters, of which the first treats of the woods belonging immediately to the Crown; the second of woods belonging to the community, and managed in common; the third treats of different forests of private persons; the fourth of *Svedjande* and *Kyttunde;* the fifth, of forest fires; the sixth, of the responsibility for depredations on forests, as well as for other violations of the laws regarding them; whilst the seventh and last chapter contains various special ordinances.

'This division differs considerably from that of the laws proposed by the Committee in 1879, and the contents differ still more.

'The chapter relative to woods belonging immediately to the Crown is introduced by the following paragraph:—

'"All woods situated apart from settled places, and desert places, also those in settled districts which are cut off from those districts, and insulated spots, and any so left by legacies, come into the hands of the Crown; and there also belong to the Crown any unclaimed spots, in regard to which no private person or community can show a better ground for their belonging to them."

'With regard to this paragraph, the Committee remark that it does not properly belong to a Forest law, but since the paragraph in question, with respect to the ordinances on which it bears, was authorised as a part of the Forest code of September 1851, Section I. of the Forest laws then settled, which it is the purpose of the newly proposed laws to replace; and since after the repeal of the statutes of 1851 no laws would exist on the principles as to right of the Crown to desert and waste places, the Committee resolved to retain the paragraph in their own proposals.

'The other paragraphs in this chapter relate to the management of Crown forests. These also, say the Committee, might be left out from the proposed laws, seeing that up to the present these laws have been managed in an administrative way; since, however, a complete code demands that forests, falling under this category, should also be dealt with, the Committee have not left them out, but have sought to give them a signification which will not hinder the Crown from managing its considerable domains with the necessary freedom. Under the said paragraphs the Committee has contented itself with the expression of the general principles, that Crown lands, not otherwise disposed of, but not declared to be a Crown park, or not proved to be necessary for this, might be let out for cultivation, so far as this is appropriate, or, in other cases, be let to certain persons, or managed for the benefit of the Crown, according to methods already in use, or which may hereafter be devised.

'In the chapter relative to forests belonging to communi-

ties, and managed conjointly, the Committee have boldly ventured to lay down regulations respecting the management of woods on land gifted to a town. On the other hand, the Committee have not, in their proposal for a new Forest law, taken up the plan mooted by the Committee of 1879, that a greater or less portion of woods belonging to town communities should be left unchanged, in case different portions or arrangements of the forest thus attached render it unsuitable for the application of the contemplated laws of forest economy; and that such portions should be placed under communal management. This, according to the views of the Committee, is opposed to the otherwise valid principle that he has the testimony in his favour who has enclosed. The said proposal seems also unjust, in so far as it introduces a difference in the law with regard to the profiting from forests, in circumstances in which the property has been acquired by the owner subject to the same conditions as others, and that merely on the ground that the (*storskiftet*) great enclosure may be made in the case of one town and not in the case of another. The proposed arrangement seems unfortunate for those who are required to administer the communal portion of the forest. For, according to all experience, the Committee remark, it is an unavoidable condition to a business association working progressively, that the partners should maintain uninterrupted respect and consideration for each other; but this can hardly be expected when the association is brought compulsorily together, and without regard to the personal peculiarities of the partners, as would be the case through the limitation of the individual freedom of the partners, arising from the formerly mentioned conditions, that the association is indissoluble, and must follow in its management a plan dictated by the Forest Department.

'In order to avoid the hindrance which the present law lays in the way of the continuous existence of agreements about the common management of the forests of several proprietors, where such agreements can be brought

into action without compulsion, the Committee have, in the chapter of their proposals under consideration, brought in a paragraph which determines the conditions according to which such agreements may remain binding for a third party. This specifies the owner's right, or that of mortgagees for any one of the proprietors whose forests have been placed under common management, and determines that this proprietory or mortgage right can only be acquired after fast adherence to the agreement already made about the management of the forests in common, and does not permit withdrawal before the time of the agreement has come to an end.

'In the chapter relative to the woods of private proprietors, which naturally constituted one of the principal parts of the Committee's proposals, the Committee has shown a disposition to intrude as little as possible into the right of free disposition belonging to the individual over his own property.

'In the outset, the Committee remark that the description of the forests of the country left by the Committee of 1874 is sufficiently gloomy. And yet from the places which the said Committee designated as already poor in wood, there has been cut and brought out since 1874 no insignificant amount of timber, and it seems, say the last Committee, that as the cutting down of timber for sawing purposes in these places still continues, it is apparent that no actual lack of timber has up to the present been experienced. The final judgment expressed by the Committee of 1874, when it declared that the cutting down of timber over almost the whole läns was carried on in a fashion which, in the event of its being continued, would lead at an early day to a lack of timber for house use over widely-extended districts, is considered by the last Committee as certainly exhibiting some degree of exaggeration. Traces of a wiser economy with regard to forests, say the Committee, have more recently more or less shown themselves, the causes of which are

not far to be sought. In the same direction, the sawing business and speculation in timber have developed themselves. Forest products, which till very lately have been almost unsaleable in the interior of the country, have also become a valuable article of trade; and just as the proprietors of forests in Sweden and Norway, under the influence of well-instructed foresters in these countries, have been led, through the high prices of timber, to adopt a more careful forest economy, so has the increased price of forest products likewise with us worked in the same direction. Every limitation of the forest proprietor's right to the free use of his own forest must meanwhile, add the Committee, only bring about an alteration for the worse; for, in whatever form it may be thought best to introduce such a limitation, the same must more or less hinder the turning to profit of the forest products in that way which the proprietor finds most advantageous to himself; and consequently it must so far depreciate the value of the wood. To limit the proprietors of forests in different ways in turning their forests to profit is moreover an invasion of the rights of property which is theirs by the fundamental law of the land. Against such a tendency this Committee also pronounced that any actual control over the carrying out of the law in this direction could scarcely be thought of.

'Still, it must not be left out of account, say the Committee, that an unwise cutting down of the forests must not only tend for a long time in the future to diminish their reproduction, but also entirely to destroy them. The Committee look upon the existing statutes which are found in section 35 of the Forest Laws of 1851, as not providing any actual remedy against such a course. For these statutes are applicable to such cases only when the cutting down of forests on a property may be regarded as dangerous to the continuance of its ability to pay the taxes; and apart from the fact that few such cases are likely to occur, this statute has at the same time this inconvenience, that forests on places which offer great

advantages for cultivation, or other use, can be entirely removed without the law allowing any proceeding against the same. This circumstance the Committee look upon as the principal cause of the fear that the forests would be destroyed, which was observable some time ago as being diffused to some extent in the land. The view of bald and bare mountains and holms, which had been formerly covered with wood, brought up at once the question, What would such a forest economy lead to if it became universal?

'To prevent this misuse or abuse the Committee advise the replacing of the statute of 1851, section 35, with another to the following effect:—"Woodlands must not be laid waste, and the proprietor must not cut down the wood on an area of more than ten tunnlands width, or within that distance from a holm in the neighbourhood of which wood does not grow; and he must see to it that on the ground, when not used for a garden, cultivated land, or meadows, or is built upon, or used for some such purpose, seedling trees to the number of at least twenty shall be left on each tunnland, or some equally beneficial means must be used for the restoration of the forest. And moreover, the Court may forbid on penalty of a fine, injury to young trees, or the cutting of them for other than household purposes, until the young wood be sufficiently grown. If the destruction of the forest does not cease as soon as the injury done to the wood has been sufficiently proved through the proper person, it shall be the duty of the Governor to request the Court to inflict a proper fine. If it still continue, the Governor may order the ground to be replanted."

'In reference to this statute, the Committee admit that the remark may be made, that this does not fully secure its end, for the wood may be much wasted and damaged without the locality be laid completely bare. As one reason why the Committee have, nevertheless, adopted the above wording of the statute, they point to the fact that nature repairs, though slowly, the damage done to the forest by improper methods of cutting; and

the Committee further reserve to themselves the right so to formulate the paragraph that most persons, without any special knowledge of forestry, may be able to judge of the damage done. Uncertainty in this law were, however, a great evil, not only for those who may break it, but for law-abiding citizens, whom revenge or ill-will might seek to visit with undeserved penalties, and therefore it is better that some offenders should escape than that law-abiding citizens should be unjustly punished.

'Respecting spots which have been leased out to tenants the Committee seek to strengthen the stated provisions, by enacting that the wood on such spots shall be protected thus: In the paragraph on forest lands appertaining to outlying settlements, intended to replace section 37 in the existing statutes for 1851, the Committee has proposed that the person or persons renting the property, or profiting by it, shall also be liable as well as the proprietor. In other cases, where persons renting, &c., have the right to take wood for house use, the Committee have proposed that such right shall not be recognised until he has expressly consented to respect the above-mentioned regulations. In this way the Committee hope that misuse and abuse of the forests in such circumstances will be lessened, if not prevented, a matter, the importance of which will be recognised, seeing that, according to the calculation of the Committee of 1874, such misuse and abuse apply to no less than 4-5ths of the existing forests in turning them to use.

'The three first chapters in the Forest Laws, proposed by the last Forest Committee, deal with forests belonging immediately to the Crown; with forests on common lands, and with forests managed in common, as also with those on private estates. We have given a summary of the main contents of these. The last section of the chapter deals with *Svedanje*, *Kyttande*, and forest fires, with the penalty for destroying forests, together with the penalties for other violations of the forest code, and last of all it contains certain single statutes.

'It had been proposed from different quarters that the practice of *Svedanje* should either be entirely forbidden, or at least greatly limited. There could be little doubt, the Committee admitted, that the practice led, mediately or immediately, to many fires, and consequently to much destruction of forest. But still, the conclusion that it should altogether be suppressed seemed to the Committee to be over hasty. For, say the Committee, the right to the exercise of *Svedanje* is a condition of the existence of the population in Eastern Finland; and whether one takes the conclusions drawn up for the Committee of 1874 by G. Rein, wherein he calculates that 100,000 tunnlands of woodland is every year subjected to *Svedanje*, or whether one bases his views on the data which the Committee received from the statistical bureau that of 940,000 tunnor of seed (säd) which were reaped in St. Michaels and Kuopio län, nearly about 110,000 tunnor were grown in *sved*, it is evidently clear that if so greatly in these parts of the Grand Duchy, where a great deal of bread stuffs have to be imported every year, they are dependent on *sved*, its entire stoppage would occasion a grievous deficiency in the food of the population. Not only so, but the means of purchase would be lessened, seeing that the butter exported is raised in no small measure on *Svedanje land*, and by the stoppage of this, this source of income and support would also be lessened. A law forbidding the use of *sved* would thus place a part of the population of the country in the difficult position of either violating the law, or of suffering from the pangs of poverty; and which of these the majority would choose, the Committee add, there can be no doubt.

'In these circumstances, it seems to the Committee that since the prohibition of *sved* is an invasion of the rights of property, and seeing the prohibition of *sved* would lessen the ability of the people to pay taxes, the legislature should be content with seeking to stop the misuse and abuse arising from the practice of *Svedanje*, and this especially on places where the practice would stop the growth of wood, if not permanently, at least for a long time. It is true

that this matter has already been legislated upon, but the Committee observe that the formulating of the statutes bearing on this point (section 5 of the Forest Ordinances of September 1851) is such that difficulties arise in its application. This is partly the case from the *sved* occasioned by cultivation not falling under this paragraph; but there are other difficulties in the application of the said law. The Committee have sought to improve the law by giving it the following form:—

'"*All use of 'Sved' is forbidden on extremely stony soils, or soils lying on rocks which they lightly cover, as also on sand covered by tall wood and heather* (*yung*). *More than two crops ought not to be taken from ground subjected to the process. Nor may the burning be repeated until the young wood has attained an age of twenty years, when the wood on it consists of 'löftiäd,' and of thirty years when it consists of 'barr skog' in considerable quantity.*"

'In connection with this, the Committee, to avoid as much as possible difficulties in the application of the law, have proposed that in the wood growing upon the place where *sved* has been exercised, the elder tree (*alder*), whose yearly growth can be sufficiently well distinguished by rings, shall be the tree according to which shall be determined the time when the place may be burnt again, *i.e.*, the longer or shorter term according as the growth consists mainly of *löf* or of *barr* forest. In the Ordinance of 9th September 1881 (sect. 49), are references to forest lands on which *sved* has been practised being prohibited as feeding ground for cattle within eight years. The Committee have recommended, on the contrary, the omission of this partly because such a law cannot possibly be enforced, and partly because the law recommends the promotion of the growth of wood at the cost of a more valuable increase in the number of cattle.

'For the same reason, to prevent unreasonable interference with personal freedom, they specify that *ris* burning

does not come under the head of *sved;* and there are also distinctions between different kinds of *sved* which the Committee have deemed it advisable to leave out.

'With respect to forest fires, besides the existing prohibition and safeguards, the Committee have forbidden the kindling of fires on property belonging to another, and also carelessness with regard to the use of fire-arms, smoking tobacco, &c., in the forest. There are also introduced other provisions with regard to incautiously carrying about fire in the forest, as also with regard to persons who may be witnesses of this, and fail to report it.

'With respect to fines, &c., for offences against the forest laws, the Committee have seen it their duty to take under consideration the laws at present in force, and determine whether these should remain in force or not, with a view, if possible, to make the penalties in proportion to the offences. They have enumerated the penalties in a special chapter, in case the forest laws should come into force before those referring to pains and penalties; and have sought thus to avoid the difficulties which might arise in this way. The circumstance that a new law as to pains and penalties is under consideration determined the Committee to leave out of consideration such questions as, for example, how far destruction of wood be likened to ordinary theft. They think that whatever views may be held on this point, so long as the law is what it is, it were better to have this settled under the head of Pains and Penalties, the working out or determination of which does not lie within the province of the Committee.

'As regards the penalties for forest offences, they have generally gone upon the principle to leave the Court free to determine within certain well-marked lines the penalties in conformity with the course of legislation in later times.

'Under the last chapter on *Special Statutes,* containing

prescriptions as to forms of process, &c., prescriptive rights, &c., the Committee, as in the preceding chapter, think it improper for them to go into matters which are better regulated by general prescription and the practice of the Courts.'

CHAPTER XI.

LITERATURE OF FORESTRY.

THE earliest publications relative to forests and forestry in Finland which have been brought under my notice, are two brief treatises, published as theses in the last century, one by Professor P. A. Gadd, and the other by Professor P. Kalm, both of the University of Abo. In the present century, Mr C. Boecker, also a professor in that University, published in 1829 a good volume On the conservation and treatment of forests in the north.

In 1829 Mr V. Ficandt published a small book On the increase made by woods in growing.

Staatsrath C. W. Gylden, the founder of modern forest economy in Finland, published in 1853 an excellent and valued work entitled *A Guide in the Treatment of Forests in Finland.*

In 1858 was published *Finlands-Skogar*, by Mr Edmund V. Berg.

In 1861 was published a treatise On the manufacture of tar in Finland, *Finlands Gaern Industrie*, by Mr A. Solden.

In 1863 was published a volume by Mr E. W. Stroemberg, On the government of Uleaborg, the principal forest län in Finland.

From 1866 to 1869 appeared successive reports of the Commission appointed to enquire into everything relating to the condition and treatment of the forests, entitled the *Stateskogs-Commissionens Beraettelse ;* and annual reports on the management of these forests—*Forst styrelsens Beraettelse*, giving details in regard to those in each of the läns, continue to be issued. Dispersed in various journals have appeared valuable treatises on matters pertaining to

forestry from the pen of Mr A. L. Borenius, Forest-Master and teacher of forestry in the School of Agriculture at Mustiala; and Dr. K. E. F. Ignatius, Director of the Government Statiscal Office in Helsingfors, has embodied in his Statistical Notices much information in regard to matters pertaining to forestry and to forest science, which I valued highly as supplying to me the information of which I was in quest when this was the subject of my study. To him and to Dr. Blomqvist, Director of the School of Evois, my obligations are very great.

By Dr Blomqvist have been published:—

1. *Tabeller Framstaellande Utvecklingen af Jemnaoriga och Slutna Skogsbestaond af Tall, Gran och Bjoerk.* Helsingfors, 1872. To this are appended seven tables and two charts of curves. These represent the increase made by the growth of the Scots fir, the Norway spruce, and the Birch, in normal forest masses throughout 200 years' vegetation. The work is based on detailed observations made in journeys through all parts of the country in the course of three years. The materials collected were very voluminous; and one may be permitted to hope that they may yet be published. Quotations from this work have been given.

2. *Naogra ord till Belysning af den Naervarande Skogs-Fraogan i Finland.* Helsingfors, 1874. A few words designed to illustrate the question of forestry in Finland. In this the question of forestry is discussed in the various aspects presented by it in regard to political economy and legislation. It is brought prominently forward that the existence and conservation of private forests is very precarious, and that to insure that a country shall remain permanently wooded, it is necessary that the forests of the domaines of the State, and those belonging to communities, should be, to a certain extent, under public control. It is shown that if the feudal *régime* had not been established in France and in Germany these countries would have been cleared of forests, as have been England, Holland, and Denmark. It is alleged that it is an erroneous sup-

position that it is practical, by a restrictive legislation, to compel private proprietors to preserve their woods. All the laws having this for their object which have been passed have had surprisingly little effect, and on this ground it is maintained that the first thing to be done with this view is what has been done to extend the forests belonging to the State in the southern parts of the Grand Duchy. It is stated with approval, that the Government had, within a few years previous, made some considerable purchases of woods belonging to private parties, amounting in all to about 200,000 hectares, to form of them new Crown parks; and that this procedure was likely to be continued for some time to come. In this work the principle of free trade is defended as the most useful for forest economy in Finland; and it is asserted that the restrictions on a free exportation of forest products, which were heard of on many sides, could only be injurious to sylviculture.

3. *Eine neue Methode den Holzwuchs und die Standorts-vegetation Bildlich Darzustellen: sechs Vegetations Bilder aus Nord-Finnland und Lappland.* A new method of giving graphically indications of the progress of forest vegetation. It is a reprint in German of a paper published in the Journal entitled *Idrag till Kaunedom om Finlands Natur och Folks*, issued by the Finnish Academy of Science for the year 1879. In four charts of different woodlands in a stretch of half an hectare are indicated, not only the locality and the magnitude of each tree, but in addition the herbaceous and arborescent vegetation giving its vegetable character to the ground.

4. *Om Froebildningens Periodicittet hos Tallen och Granen samt roerande Ekorrens Foerekommande i Finland.* A treatise on the periodicity of fructification in the Scots fir and the Norway spruce, and on the periodicity of the squirrel (*Sciurus vulgaris* L.) in Finland. It is a reprint of a paper published in the journal entitled *Meddelanden af Societas pro Flora et Fauna Fennica.*

Besides these, several valuable papers by Dr Blomqvist

have appeared in various journals and gazettes, and in the *Finska Forstfoereningens Meddelanden*, the Journal of the Finnish Forest Society, a society of which he was the founder, and is the President, and the conductor of the journal. Amongst the longer and more important papers from his pen which have appeared from him in this periodical is one *On the Pruning of Trees*, a reprint of which, in the Swedish and Finnish languages, has appeared; and another On the international position of Finland in regard to forest production, with tables of the trade of Europe at the present time in wood, and articles made from wood. But the most important of all is a monogram on the *Pinus silvestris*, the first of a series on the forest trees of Finland, described from a forestal point of view, *Finlands Traedslag I Forstligt Haenseende Beskrifna.* It is a monograph occupying an entire number of the journal, some 200 pages. It is the most special treatise on this tree which has yet been published, and is illustrated by representations of pines characteristic of those of Finland, and more especially of the northern part of the country. It is shown that the race of the *Pinus silvestris* in Finland appears to be very superior when compared with those of Central Europe, as for example of Germany, and that seeds imported thence cannot stand the climate of the north. It is stated that this tree is the most dominant one of Finland: more than 0·9 of the entire surface is covered with it. But the Norway spruce is gaining ground every year; and it is alleged that throughout the whole of the north of Europe there is year by year coming on a time, within perhaps a century from the present, when the spruce (*Pinus abies*, Linn.), will be the dominant tree. This phenomenon of regeneration, or rather of succession, is to be met with everywhere in Scandinavia, as in Finland and in Russia, on to the Ural Range, and even beyond these mountains.

The second volume of the series, a monograph on the spruce, will, I am informed, be published within a year from the present time.

To him also we are indebted for a *Catalogue Special d'objets Forstiers enyoyés à L'Exposition de Moscow in* 1882, *par L'Institut Forestiers D'Evois en Finlande*, in which is embodied much valuable information.

With the exception of two, all of the works I have mentioned were published in Swedish. A few others have been published in Finnish, but Finnish literature is as yet, even in Finland, in a nascent condition. These are *brochures* designed for the people, and they may be considered translations from the Swedish. All of them are good. The most noticeable of them are the following:—

Lyhykaenen Metsoewho i Donoppi. By M. A. Wahlroos. Helsinki. 1874.

Etsoenkasvatuksesta. By M. P. W. Hannikainen, Turussa. 1880.

Helsien Hoidasta. By M. P. W. Hannikainen, Helsinki. 1883.

The reports of successive Commissions appointed by the Government to enquire into the state of the forests, and of the management of these, having been mentioned in the notices given above of the literature of forestry in Finland, I may state in connection with this that the successive chiefs of administration of the State Forests were:—

From 1851 to 1864, Staatsrath Claes Wilhelm von Gylden, founder of the School of Forestry at Evois, author of one of the books of which mention has been made, and founder of the modern forest economy of Finland. A biography of him, with a portrait, occupies the first volume of the *Finska Forstfoereningens Meddelanden.* He was a man highly distinguished; and exercised great influence on the development of the Forest Administration in Finland;

From 1864 to 1870, Baron R. Wrede, a military officer;

And from 1870 to the present time, Mr A. de Forselles, of whom mention has been made in connection with the founding of the School of Forestry. He was originally, as

has been mentioned, a military engineer; but after 1857 he gave his attention to the study of forestry. He now holds the position of chief of the department.

Amongst statesmen who have exercised a beneficial influence on the development of forest interests in Finland special mention should be made of Mr L. G. Von Haartman, Minister of Finance, who died in the year 1858; of Mr Fab. Von Langenskioid, Minister of Finance, who died in 1863; and of Mr Oscar Norrmen, head of the department of agriculture in the Finnish Senate, who has done much for the promotion of railways, and for the promotion of agriculture; but to whom is especially due thanks for the purchasing of new *Kron parks*, or state forests to which he has of late years given his attention.

PART III.

PHYSICAL GEOGRAPHY.

CHAPTER I.

CONTOUR OF THE COUNTRY.

In the opening chapters there has been given some information in regard to the lakes and rivers of Finland, from which not a little may be gathered in regard to the appearance of the country, and in regard to its contour. But the subject was then looked at more in its hydrographical than its geographical aspect; and it is the latter which here comes under consideration.

Finland is washed throughout a great extent of its circumference by the sea, the Gulf of Finland, the Baltic, and the Gulf of Bothnia, and it is throughout its eastern boundary conterminous with Russia, to which it is annexed. Boundaries of kingdoms having been determined in many cases by considerations altogether independent of natural boundaries suggested by river-courses, or by what to students of physical geography may seem more natural still,—the watershed of the elevated ridges which determines the river basins, the traveller finds often in the speech and appearance of the people, and of the houses and villages, the first, and sometimes the only intimation that he has passed from the territory of one government into the territory of another; and it may be, that in the northern portion of this boundary line, the traveller may meet with little else to let him know, when he has crossed it unintentionally or of design, that he has passed to or

from a Grand Duchy, which, though an integral part of the Russian Empire, is a land inhabited by another people, speaking another tongue, worshipping after another form, and to some extent governed by another code. But near the boundary line formed by Lake Ladoga and the Neva, it is somewhat otherwise. The first station on the Finnish railway from St. Petersburg has scarcely been reached before the traveller feels as if he had got into another land, and at Shoovalova, eight or ten miles from St. Petersburg, he sees lakelets and wooded knolls such as are characteristic of the country.

I am fain to avail myself of the graphic sketches supplied by Dr. Helms, who says:—'With the sea on the south and the west, a natural boundary of rocks on the north, and desert steppes and lakes on the confines between Finland and Russia, the country is marked out as a well-defined geographical district. It is not less distinguished by its geological formation, its fauna, and its flora, and the character, customs, speech, history, and marked individuality of its inhabitants.'

And, comparing the outstretched and embracing arms of the sea—the Gulf of Finland and the Gulf of Bothnia—to the arms of a mother outstretched to embrace a lost daughter, he speaks of the designation 'Last daughter of the sea' as less a poetic fancy than a beautiful representation of what have been the facts of the case, borne out by what may be considered traditions embodied in names preserved from ancient usage, and in such designations as are preserved in the expression *Suomen-niemi*, Finland's capes and promontories, and *Suomi-saari*, Finland's islands. And when one travels through this 'Land of a thousand lakes,' sees these hill and mountain-begirt lakes and lochs, often numbering a hundred, met with in the course of a single day's journey, and sees valleys now dry, but with deep mosses, or the remains of the lakes which in the olden time rolled in waves over the place, and sees the deep caverns or hollows which the sea has eaten into the rocks,

and looks at all this in the light of traditions still in the mouths of the people, which tell of wrecks of ships found on the heights of mountains in the interior of the country, his thoughts are naturally carried back to times in which the waters of the ocean covered the whole of Finland, and only the highest crests of the mountains rose above the waste of waters; and it is felt to be beyond doubt that the sea must have receded only as the land rose by upheaval, hills, heights, and high lying places rising ever higher and higher. The sea would be caught in innumerable little basons in the valleys and depressions, but, fed there by springs and melted snow, its water diluted and carried away, the water would gradually lose its saltness, and would come to form that inland archipelago, that coronet of inland seas, which in the midland and eastern portion of the country catches the eye unceasingly. Thus does Finland appear as a country which has escaped from the sea, and by slow degrees delivered herself from the waters of the two Baltic gulfs which still enfold her, as if unwilling to give up their hold. For even to-day this thousand-year-old process of nature may be seen to be still going on.

'Looking along the coasts of Finland everywhere are seen indications that the sea is slowly, but gradually, receding. Places which two centuries ago were on the coast now find themselves a considerable distance from the sea; different havens on the coast are becoming useless from the upheaval of the land; lakes and rivers are turning shallow, as through that upheaval they have a greater fall in the flow of their waters to the sea. Along the western coast of Finland are every year extensive stretches of land gained from the sea, and new islands arise out of the waves; and recorded elevations above the sea level, which are scarcely a hundred years old, testify to the same fact. The Fortress at Abo is now some feet higher above the sea level than it was a century back.

'This upheaval of the land varies in different localities. It is less marked on the south coast and in the Gulf of

Finland; it is more marked on the northern parts of the Gulf of Finland. In the stretch of land in which it is most apparent—mainly between Torneā and Wasa, it is calculated to be proceeding at the rate of 4½ feet per century; the south coast has risen within the hundred years 2 feet, or, more exactly, 1·93 feet. Let the thoughts go back some 700 years, when the country was first conquered by the Swedes, at which time the coast was in some places 14 feet, and in some 31½ feet higher than it is now, and what a different aspect must the country have presented. And could we carry our thoughts forward to a remote future we might possibly reach a time when Finland shall have freed herself altogether from the grasp of the sea, and what are now gulfs—that of Bothnia and that of Finland—alike shall have shrunk to narrow and insignificant channels, fed only by the rivers flowing into them.

'Both in this which may be called Finland proper, and in the Nyland, we meet with rising grounds and sheets of water. These gradually become more numerous and more extensive as we advance into the interior, and to the east, until at length we step from one height to another, and from one lake to another, until fancy suggests, as we look upon inland seas and rivers, bedecked with innumerable islets, that it must be some marine landscape upon which we gaze. Thus does the eastern portion of Finland present a striking contrast to the western; and while the coast, with its cultivated fields, and romantic island studded creeks, has lured the Swedish settler by its natural resemblance to his home, the highlands have an impress of earnestness, firmness, and sincerity, corresponding to the peculiar national character of the Finnish people.'

The reference made by Dr Helm to the upheaval of the land seems to me to require some illustration. Such changes in the altitude of portions of the earth's surface are not unknown elsewhere. In a volume entitled

*Hydrology of South Africa** I have had occasion to state :—

'In many atlases published in illustration of physical geography there may be found maps representing the results of observations carefully made by scientific men of similiar changes in various parts of the world, horizontal lines being employed to indicate areas of subsidence, while those of elevation are marked by vertical lines, and intermediate districts of indecision are pointed out by crossings of the two sets of lines.

'By a representation of these already spoken of, it appears, as has been intimated, that throughout the region of the West Indies, and the western coast of Mexico and South Africa, and throughout a triangular space, included by a line through these places, subtending an angle at and including the Sandwich Islands, a right angled triangle, measuring upwards of 100° of longitude, and 75° of latitude, the land and ocean bed are rising ; that, throughout an irregularly formed figure, including Australia and the islands of the south Pacific, 145° of longitude and 75° of latitude, the land and ocean bed are being depressed ; that, throughout the Gulf of Bengal, the China Sea, and east to the Carolina's, including Sumatra, Borneo, and the Phillipine Islands, the land is being elevated, which is also the case in the Mauritius, Madagascar, and along the east coast of Africa, while that portion of the Indian Ocean which lies between these and the west coast of India is being depressed.

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* *Hydrology of South Africa ;* or details of the former hydrographic condition of the Cape of Good Hope, and of causes of its present aridity, with suggestions of appropriate remedies for this aridity. In which the desiccation of South Africa, from pre-Adamic times to the present day, is traced by indications supplied by geological formations, by the physical geography or general contour of the country, and by arborescent productions in the interior, with results confirmatory of the opinion that the appropriate remedies are irrigation, arboriculture, and an improved forest economy ; or the erection of dams to prevent the escape of a portion of the rainfall to the sea—the abandonment or restriction of the burning of the herbage and bush in connection with pastoral and agricultural operations—the conservation and extension of existing forests—and the adoption of measures similiar to the *réboisement* and *gazonnement* carried out in France, with a view to prevent the formation of torrents and the destruction of property occasioned by them. London : Henry S. King & Co. 1875.

'In 1596 several towns in Japan were covered by the sea; in 1638 St Euphemia became a lake; in 1692 Port Royal, in Jamaica, was submerged; in 1775 the great earthquake of Lisbon sank many parts of the Portugese and African shores 100 fathoms under water; in 1819, at the mouth of the Indus, a large tract of country, with villages, was submerged, while a new tract was elevated, called the "Ullah Bund;" in 1822 about 100 miles of the Chili coast was elevated to the height of four or six feet.'*

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* The late Professor Nicol gave the following beautiful illustration of the fact of depression and upheaval of land going on over extensive areas of the world's surface, in his work entitled *The System of the World*:—

'The vast expanses of the Southern Ocean are peopled near the surface by inconceivable throngs of creatures of extreme minuteness, whose continual, incessant, and inexplicable activities are, nevertheless, efficient towards building up the coral rocks. The chemistry by which the Nautilus elaborates its gorgeous shell, apprehended by the instinct of these living molecules, enables them, as they work in myriads, now to erect a fabric solid and extensive as a bed of limestone, now regular and convolved like the human brain, and again so delicate in fibre, and of whiteness so snowy, that it equals some cherished plant in fragility and beauty. Now when traversing the Pacific, the Naturalist meets with a display of this architecture of most peculiar arrangement, and which by its magnitude and immense diffusion—for its separate instances are strewn along many thousands of miles—has never failed to fill him with a just astonishment. It is an island—if island it may be called—which consists simply of a circular coral reef, of the average width of a quarter of a mile, enclosing an area varying from a mile to fifty or sixty in diameter. The features even of one such object are sufficiently singular. The insects, for instance, that formed it cannot live beneath a certain depth, and the coral fabric often arises in the midst of waters so deep that we can nowise fancy it to have been built up from the bottom of the ocean. The difficulty was at first apparently overcome by the supposition that the creatures had reared their stupendous walls on the rim of the crater of a submarine volcano, long probably extinct; but overlooking the improbability of craters existing there of a size that rather likened them to the prodigious formations in the Moon than to any exemplar upon Earth, the explanation failed in regard of the two most important and characteristic facts of the case. In the first place, the existence of the coral reef has been recognised at depths quite beyond the limit at which any insect can now carry on its work: but inasmuch as this phenomenon might be supposed only to point to a disappearance, in the course of the world's history, of species of creatures fitted to live at such profundities, I insist the most on another argument, which seems to admit of no reply. The proposed solution takes no account whatever of the countless numbers of those islands which stud the Pacific, along a line of upwards of four thousand miles. The question as to the various depths at which corals, living or extinct, could possibly have elaborated these rocks, is doubtful only in regard to a number of feet wholly insignificant in respect of any large elevation; so that the foregoing hypothesis would imply the existence over that immense extension of ranges or groups of submarine volcanos, or other mountains *differing by no appreciable amount in altitude;* and this also without regard to the absolute depths of the ocean on whose floor they rest. It were, in fact, as if over some wide continent—irrespective of valley, low land, or table-land—groups and ridges arose, across whose peaks a plane might be stretched so as nearly to touch them all; and surely nothing can be conceived more opposite to what is visible—nothing less analogous to the jagged and varying outline of the most regular masses of existing mountains. That these coral reefs must rest on the tops of submarine elevations, is manifest; but some new feature or element is thus clearly wanting to render the theory inclusive of all the phenomena. Now this element is supplied, if, as suggested by the sagacity of our admirable Darwin, we suppose these mountains placed on an *area of subsidence*. Picture, for instance, some island, whose coasts are now encircled by a fringe of coral, gradually sinking

In these cases the depression has been attributed to the yielding of the earth's crust to the superimposed weight of a deposit of earthy matter brought down by rivers, and carried thither by oceanic currents, and the elevation to the internal compression which is thus occasioned.

What is alleged in regard to Finland is, that while the ice covered deep the land, this must have been by the superincumbent weight depressed below what is its present altitude above the level of the sea; and that as this became

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first beneath the surface of the waters, and by continuation of the same mysterious workings of Nature, afterwards deeper and deeper in the sea. The process, as usual with mighty operations, being eminently slow and gradual, contains nothing to disturb the labours of the tiny architects who had, in the shape of a fringe, laid the foundation of their wall. Ever as the island sank, their edifice would rise to the surface; on the disappearance of dry land in its interior, it would first assume the aspect of a circle of coral; and this, ever added to with perseverance the most marvellous, might, through all future ages, preserve its crest on a level with the waves, although the solid land that constitutes its base had long disappeared among the profoundest depths of the ocean. But the explanation, which thus meets every difficulty in the case of a single atoll, can account for their diffusion over any extent, or in whatever numbers. Suppose, for instance, that these islands of ours had, in the course of the mutability of Nature, passed through their epoch of stability, and were now slowly subsiding. In the course of centuries—their mainland having sunk under the confluence of the Atlantic and German Oceans—there would remain, of their present greatness, only a number of islets, constituted by our mountains, around which we may fancy coral fringes to begin to grow. Now—subsidence continuing—the lowest peaks would first disappear, bequeathing only an atoll as their memorial, and although Ben Nevis might remain for centuries longer, with its crest above the waters, it, too, would be submerged, and we should have no other trace of its existence. The area of Great Britain would thus be changed into a sea of circles of coral, presenting, in miniature, what exists at present over an immense expanse of the Pacific. The conclusion, however strange, seems irresistible. Occupying that mighty area,—in length, according to Darwin, 4500 miles, and now filled only by these atolls and a few groups of islets (summits of mountains not yet wholly submerged) —a majestic continent must have existed, and taken part in the history of the Earth's evolutions, during epochs comparatively recent; and of all the gorgeous life and lofty activities which must have thronged it, there remains but the incessant working of these infinitesimal creatures, whose structures so emphatically indicate the place of its tomb.

'But other features of those seas are equally pregnant; and we must peruse them ere the picture can be complete. Whilst immense and uninterrupted tracts are characterised by the exclusive presence of these atolls, many in their neighbourhood exhibit a totally different character. They are occupied, also, by islands; but, among them the coral rocks abound *in the interior*, often rising in terraces as we proceed inward, until we follow them almost to the tops of the highest interior elevations. Now it cannot for a moment be doubted that these corals were formed under the only condition in which corals can be formed, viz., below the surface of the waves; and knowing of energies manifested in the volcanos, which can rend the solid earth, and force large mountains through its crevices, the inference is easy, that these islands must have been *elevated*, and, as indicated by the *terraces*, perhaps *gradually*, from a former inferior level. But this inference is rather sustained and its significance extended by two important facts: First, as in the previous case, the symptoms of elevation *exclusively* characterise large isolated tracts, being, for the most part, unmixed except at their margin, by symptoms of depression, so that we cannot refer them to partial elevating movements, but to an action including *great areas within its range;* and this is confirmed by the circumstances, that to these areas our clearest evidence of the energy of a protruding or upheaving force from below, viz., the volcano, is at present confined.

removed by being melted and run off as water, the land rose to its present altitude. In regard to the contour of a country which has passed through some such change of altitude, it is stated by Sir John Herschel:—

'In the upheaval of any extensive tract of land from the sea, hollows fitted for lake-basins cannot fail to be left. If the upheaval be rude and paroxysmal, resulting in the formation of mountain chains, and accompanied with fracture and dislocation of the strata, such hollows will be

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How extraordinary the scene we have here unfolded! Through all the wide solitude of the Pacific, from which no tidings were wont to come, except of scattered tribes of savage people, or of new and rich aromas, we are now summoned to discern the manifest progress of the most stupendous changes to which our world can be subject; mighty movements of its solid crust, here subsiding and carrying for ever from human sight the marvels of great continents, and, elsewhere, promising the birth of new ones, amidst the deepest silences of the ocean'

And he goes on to say—'That there is no portion of these continents which has not been subject to such memorable revolutions. That the whole land now protruded above the waves, had long lain at the bottom of oceans, appears from the character and contents of all the sedimentary rocks; for while these demonstrate, by their structure, that they must have been deposited by the agency of superincumbent waters, they envelope, now turned into stone, the remains of the sea-creatures that lived on the floor of the ocean, when the stratum of mud, or sand, or lime, was there spread out, which through the course of ages has become hardened into a corresponding rock. To dwell on a consideration, at the present time so generally understood and accepted, does not appear needful; but a careful analysis of the rocks of these continents has revealed another feature in the history of the changes which have affected the Earth by far too remarkable to be passed slightly by. Not only have our existing masses of land been subjected to a process of *emersion*, such as those tracts in the Pacific are undergoing, by whose gradual rise novel forms and combinations are visibly preparing, but it is certain that they have experienced many and signal *oscillations*, now sinking beneath the sea, now reappearing, so that those grand metamorphoses of the surface of our Planet seem almost without limit or end. Look in illustration to the south-eastern counties of England. We discern there, as characteristic of extensive localities, three singular formations of considerable thickness.

'The lower and upper formations are *marine*, that is, they contain solely the relics of creatures that lived in the sea; while the middle one, consisting of three distinct beds, is entirely, or very nearly, of *fresh-water* origin. Now, observe the significance of this curious intermixture. When the stratum No. 1 was deposited, it is indubitable that the whole wide surface over which it is diffused must have been the floor of the ocean. On the deposition of No. 2, which required the agency of a lake or river, the first bed must have arisen from its previous depths, and constituted part of the dry land. Ages had then passed,—the beds of No. 2 being meanwhile formed in quiet and perfect order; and, at the close of this period, the land must again have sunk, and received from the ocean the superincumbent chalk of No. 3, which by one more of those stupendous revolutions has since been heaved up, so as now to constitute the bright cliffs of that portion of our island. Two grand movements of upheaval, and one at least of subsidence, are thus demanded for the explanation of this mere leaf in the annals of the earth; and a minuter inquiry would only add to the variety, and the better impress the majesty of these changes. The intermediate fresh-water formation, for instance (the Wealden), was the estuary of a river rivalling the Ganges, which there delivered its volume of water into the ocean. Now that river must have drained some continent of magnitude corresponding,—a continent (as we learn from the scattered bones buried in the mud of its estuary) filled with life in some of its strangest and most gigantic developments; and that has wholly disappeared; carried downwards, either entirely or in parts, by the subsidence which prepared the Wealden to receive the chalk.'

deep, precipitous, and narrow, in proportion to their length. Such is the general character of the lakes in mountainous regions—of the Swiss lakes for instance, those of North Italy, of Cumberland, Westmoreland, Scotland, &c. On the other hand, where the upheaving forces have acted more gently, and gradually, and have raised the country with more uniformity, producing extensive plains and low steppes, lakes will not only be more numerous, by reason of the less erosive power of running water to drain them by deepening the outlets, but will effect more rounded forms, and cover the country with shallow pools or ponds void of all picturesque beauty, as we see exemplified in Poland, and in the districts between the Gulf of Finland and the White Sea, which are almost connected by a chain of shallow lakes. Some of them (as those of Onega and Ladoga) very extensive.'

Finland is situated between the 60th and 70th degree of north latitude, and the 38th and 50th degree of longitude east of the Faroe Islands. 'Its area,' says Dr Ignatius, 'is about 6800 geographical square miles. Its surface presents a singular aspect. In an accurate map it presents such a confused culmination of land and water that one can with difficulty trace dissevering outlines. The coast, extending over 1400 kilometers, is cut up excessively, especially in the south and south-west, and is begirt with an archipelago of rocks and islands innumerable, called the *Skärgärd* or bulwark of Scar rocks. It is impossible for a stranger to guide his vessel without a pilot in this labryinth of straits and gulfs, through the islands and rocks which spread out before him, as far as his eye can reach, immediately he approaches these coasts. This archipelago presents an exact counterpart to the general configuration of the country itself in its general features. Here the islands are ridges and hills, the gulfs are represented by valleys, the depths of which are filled with lakes, especially in the interior of the country. In sailing on these lakes one may imagine himself still in the

archipelago; there is the same multitude of islands between which the water now compresses itself in strait canals, and now spreads itself out in vast basons, which measure often many Swedish miles in extent; only here nature presents more of a smiling aspect; the dry and bare rocks of the archipelago are replaced by islands verdant and wooded; the heights are covered with pine forests of dark green, and on the shores are seen villages and cultivated fields.

'No country in Europe, and perhaps no country in the world, can compare in number of lakes with Finland. It is reckoned that they cover 12 per cent. of the whole superficies; but this does not nearly represent the whole portion covered by water; there must be added 20 per cent. covered by marshes and peat-bogs, for the drainage of which nature and man must yet in combination labour for centuries. In looking on the map, with these considerations present to the mind, we are naturally led to the conclusion that Finland has been the uneven bed, not yet completely desiccated, of a sea which, in retiring, has left water in the parts of lowest level. A fact long maintained by popular tradition, and one which has received confirmation from observations continued for more than a century past, is that the soil of Finland is being continuously elevated above the sea-level. It is calculated from observations of permanent marks on rocks washed by the sea, that this elevation is going on at the rate of about 40 inches in a century on the coasts of the Gulf of Bothnia and at Qvarken, and 24 inches on the coast of the Gulf of Finland.

'At the same time, if we call Finland a young country, in the sense that of the countries with which it is connected it has been, perhaps, the last of all to be raised above the level of the sea, and fitted to serve as a dwelling-place for man, it is in this sense alone that the designation can be given, and not in reference to its geological formation.'

Of the general appearance presented by the rivers and lakes of Finland ample details have been given; and

nothing must be added here in regard to the hydrography of the country; but in regard to the correlated feature of the country—its oreography, some additional information may be welcome.

'The mountain ranges of Finland' writes Helm, 'have few remarkable elevations to show, and as we proceed southward the more level does the country become. The great Norwegian mountain range, which extends to the White Sea, stretches out an area of rocks towards the south-east, which divides itself into smaller ridges and solitary mountains, such as: Peldvioi, 2000 feet, and Quanastuntivri, 1931 feet in height, until at last, in the region of the sources of the Tana Fluss, it assumes the peculiar form of land ridges called Maanselka, here appearing as an elevated plateau, a table land, there as sandy steppes, there as wood-covered heights.

'The mother ridge, which gives rise to numerous branches, two of which stretch away direct to the northern coast of the Gulf of Bothnia, proceeds first in an easterly direction to the boundary of the Government of Archangel, and thence it wends its way southward, constituting one part of the western boundary of Russia, and extending itself in various curves, westward and southward, bounding on one side the Province of Easter Bothnia, Karelia, Savalar, Tavastland, and Sata Kunder, it becomes gradually less, and finally disappears near to the sea in the district of Christinestad. In its long course the Maanselka throws out a great many wooded hills and irregular groups of heights, and these, with the enclosed sheets of water, form a circlet of picturesque scenery around the included country.

'Proceeding from the mountainous region of Lapland and Haiden we find small plains on the north-west coast of the Gulf of Bothnia, but here as yet often broken up and interrupted, until at length, at the entrance to Wasa län, is seen the vast extended fertile plain of East Bothnia, bounded on the north, east, and south, by the Maanselka and its branches, and here and there towards the sea, sown, as it were, with hills.

On the same subject Dr. Iguatius writes :—'Finland is not a country of mountains, although the surface is marked by inequalities, and the heights are composed of granite masses. It is only in the northern part in Lapland that we meet with mountains of some importance. The highest of these is the Haldefjäll, or, as it is called in Lappish, *Haldischok*, which attains an elevation of 1258 metres. It is situated at the extreme north-west, on the confines of Norway, and it belongs properly to the Norwegian Alps. And the same may be said, geographically speaking, of other mountain summits situated in the small Lappish territory of Enontekis, which runs in as a corner between Sweden and Norway. Outside of this territory, the principal mountains of Finland are the Pallastunturi, 858 metres; the Peldoaivi, the Ounastunturi [the *Peldvioi* and *Quanastuntivri* of Helm], all in Lapland. To the south of the Artic Circle no mountain summit is 600 feet above the level of the sea, and very few exceed half that height. There may still be found at Kuusamo some elevations which attain the altitude of 865 metres, but further to the south they are much below that. The highest of the hills which has been measured in Southern Finland is the Tiirismaa, in the parish of Hollola, to the west of Lahtis. It does not rise more than 230 metres above the level of the sea. The mean elevation of the interior of Finland is about 100 metres.

'With the exception of the moraines, of which mention has been made, the elevated ground of Finland does not form regular mountain chains well defined. Those which are found in maps are inserted, for the most part, to indicate the watershed, but the traveller traversing the country will often find it difficult to observe them. The most important of these is the Maanselkä, or the "Back of the Land," which separates the waters which flow into the Frozen Ocean from those which flow into the Gulf of Bothnia. After having followed in the north the Russian boundary, the elevation bends away to the west near to Moentoenvaara in 64° N. lat., where it takes the name of

Suomenselkä; it then takes a south-west direction, and finally arrives at the promontory of Sideby, between the provinces of Satakunta and of East-Bothnia where it gradually sinks to the sea-level. It constitutes the boundary to the north and north-west of the interior of Finland, a country characterised by inequalities of soil, cut up by elevations and lakes, and it separates it from the low and continuous plain which forms the south coast of East Bothnia. Three branch chains separate themselves from the Soumenselkä; these are the Savonselka, the Haemeenselka, and the Satakunnanselka; they take a southern direction, and combine at their extremity with the Salpausselka, enclosing thus the whole central portion of Finland, which they divide into three basins, of which the lakes of Savolaks-Karélie in the east, and of Tavastland in the west, fill the lowest lying parts.'

CHAPTER II.

GEOLOGY.

Section A.—Geological Formation.

Of the geological formations of Finland Dr Ignatius writes:—'They carry us back to the primitive geological epochs. They are composed in great part of crystalline rocks covered with a comparatively thin layer of earth of the post-tertiary period. With regard to their origin, these crystalline rocks are, some of them, schistose and metamorphic, the others compact and igneous. These are for the most part of the old Taurentian formation. The second, having been erupted from subterranean sources, have traversed the former, turning them over, and covering them in some places over an immense extent of surface. It is these igneous rocks also which form the greatest part of the mountains of Finland. They are divisible according to age, into three principal groups characterised by different granitic formations—granite-gneiss, predominating to the south of Salpauselkä; porphyritic-granite, covering wide extents, especially in the centre of the country; and pegmatite-granite, which, in the form of thin *filans* (of quartz, and of granite, of fine and of coarse grain), are met with in all the other rocks, metamorphic and plutonic. Amongst the granite-porphyroids may be specified one form which the Finnish call *Rapakivi*, which is well known from the facility with which it is crumbled; it is found especially to the south of Salpauselkä, in a limited space, bounded on the west by a line drawn from Borga to the lake of Päijänne, and on the east by the Vuoksi and the Aeyräpaanselkä, a chain of hills which runs from the

Vuoksi to the Gulf of Finland. This stone is used for laying roads, and to it is attributable the fine condition of the roads in Finland. There are found also in the same lands as the granite porphyroids other allied rocks syenite, diorite, &c. Porphyry, strictly so called, is met with in the Island of Hogland.

'The layer of mobile earth is composed of the *débris* of all the kinds of rocks found there, mixed with sand, clay, and vegetable and animal matter. Considerable areas are covered with sand, clay, and gravel, and require from the agriculturist great effort and indefatigable perseverance to bring them under culture. Other grounds more favourable for culture are composed of clay, or of heathland mixed with sand, or, what is still better, as in the Government of Wasa, of peat soil or vegetable earth. Layer upon layer of vegetable *débris*, decomposed and carbonised, are being deposited on the area of marshes, forming peat, which, when drained, becomes firm arable land. The animal kingdom has contributed more sparingly to the formation of the soil; but on the coast, for example in the Nyland, in the environs of Nadentdal, near Abo, in the Island of Aland, and in Central East Bothnia, the ground, at some places to many feet in depth, is formed of the *débris* of shells belonging to animals still living in the Gulfs of Finland and of Bothnia. There are found also in the interior of the country the remains of animals which live in fresh water. These are varieties of tripoli, composed of the scales of infusoria, in prodigious numbers. The people call this tripoli Mountain Meal; and in years of dearth they have used it as food, mixing it with flour whereof to make bread.'

According to Dr Helms, 'The soil of Finland is in the northern part, and more especially in the high-lying portion of it, to some extent sandy, and in every respect more suitable for pasturage than for agriculture. A great part of the coast, however, where the level plains have evidently been at one time a basin of the sea, and

also some districts in the interior of the country are extensively permeated by great beds of limestone; and the lands are rich in humus. The most fertile of these is the great plain in the district of Wasa, and the Kyrofluss, famous for the excellence of its rye. A great portion of Finland, namely, the northern and the eastern, is covered with numerous marshes and moorlands, while in other parts vast morasses extend themselves widely, which here and there support heaths and other bushes. The forests are somewhat sparse and thin on the stretches of land near the coast, but in the interior there is no lack of these.

'The morasses, swamps, and lakes cover about one-third of the whole surface of the country. They are, in many respects, prejudicial to agriculture; they affect the climate unfavourably, through the cold and unhealthy evaporation which proceeds from them, and they often lay waste fine fields with a freezing exhalation.

'During a winter which, in some districts, extends over two-thirds of the year, everything lies on the ground prostrate, the rivers and the torrents cease to flow, and they are not unfrequently frozen down to their greatest depths. The sudden appearance of summer speedily melts both ice and snow, from which it follows that the rivers rise and tear along with force; the existing water-courses, rivers, great and small, and brooks and streams, are all of them inadequate to the carrying off of such a mass of waters; the water rises higher than the banks, here and there it breaks through or overflows them, and carries away with it trees, and earth, and stones; these again accumulate at different spots and increase the overflowing inundation, which often extends itself more than a mile on both sides of the channel. In many places badly constructed dams for corn-mills, saw-mills, and fisheries, giving way, have added to the destructive effects of the inundation. If these inundations come early in the season, then is the Finlander happy. But if the spring be late, or the inundation leave the water long on the land, and sometimes it remains all the summer through, then not only is the harvest and the whole

produce of the year lost, but the soil itself is so soaked that for many years thereafter no crop can be raised. Another interruption to agriculture is the constant rolling down of stones from the heights which occurs everywhere.'

Section B.—Indications of Glacial Action.

In reference to the fact that Finland has been called, and called with some propriety, 'The last-born daughter of the sea,' I have, borrowing a statement from Dr. Ignatius, in which it is said:—'If we call Finland a young country in the sense that of the countries with which it is connected it has been, perhaps, the last of all to be raised above the level of the sea, and fitted to serve as a dwelling-place for man, it is in this sense alone.' In connection with the statement cited, Dr. Ignatius, goes on to say:—

'This epithet is not at all applicable to it in regard to its geological formation. If we take into account the periods of vast duration which have preceded the appearance of man, and of the vegetables and animals with which we are contemporary, then Finland is a very old land indeed. In point of fact, its mountains are all of them of primitive formation; they are composed of gneiss, porphyre, syenite, diorite, euphotide, hyperite, and other allied metamorphic formations, of a more ancient Laurentian formation of gneiss, and of a more recent Huronian formation of slate. There remain no traces of vegetable or animal life from the remote ages in which these mountains were formed; no fossils; no coal. Geologists admit that in the primary, secondary, and tertiary periods, Finland stood above the waste of waters, but bare and desert, and that during the whole of this latter period she was, as Greenland is at present, covered with an immense glacier, which kept advancing to the south-east by a slow, almost imperceptible movement. Under the weight of these ice masses the ground was pressed down; but afterwards, the glaciers receding, the ground began to rise again. Long and narrow chains of mounds of a formation posterior to

the tertiary period, composed of pebbles, of gravel, and of clay mixed with sand, which surround the interior of the country, mark the limits of successive masses of these glaciers; they are probably moraines, formed on one hand by gravel deposited by the glaciers, and on the other by the action of the waves of the sea. The most remarkable of these chains is that which forms the environs of the town of Joensuu, stretching in a curve along the south and south-east shores of the lakes of Karelia and Saima to Lahtis, at the southern extremity of the basin of the Päijänne, whence it turns to the south-west, and terminates near the promontory of Hango. It well merits the name given to it, *Salpausselkä*—barrier or enclosure, for it appears as a dyke to the lakes of the interior, the waters of which have not succeeded, except in two narrow passages —that at Imatra, and that at Keltis, on the Kymmene—to wear away a passage to the sea. Another similar chain, parallel to that mentioned, but smaller, and more frequently interrupted by lakes and rivers, runs a little further to the north by Kesaelaks, Parikkala, the islands and promontories of Lake Saima, Savitaipal, and thence, always holding west, to Anianpetol. It is thus beyond contradiction a terminal moraine marking the limit of the glaciers after a second recession. Other chains of a similar character in the interior of the country, the formation of which is due, according to all probability, to the action of the water proceeding from the ice-sources, have a direction, for the most part, from the north, north-east, and the north-west, towards the south, south-east, and the south-west; it is in like manner the case that the lakes of the interior stretch in this direction, and that in this direction are disposed the stratifications of the ground.'

Everywhere in Finland may be seen rocks rounded, smoothed, and marked with *striae*, minute parallel scratchings. Two theories have been advanced in regard to the production of these elsewhere, which are no less applicable to the phenomena presented by the rocks in Finland.

Both theories attribute them to the action of ice. In one of these, advanced and expounded in a volume entitled *Frost and Fire,* by Mr J. F. Campbell, they are attributed to the friction of icebergs and icefloes, drifting from the north on ocean currents. In the other, advanced, maintained, and illustrated by Agassiz, Ramsay, Lyell, Chambers, Jamieson, and Geikie, they are attributed to the grating action of glaciers, or land ice, formed where they are seen, or at a somewhat higher level, and continuously descending in a state of flux to a lower level.

By some of the geologists whom I have cited it is held that in what is known as the glacial period Scotland must have been covered with one wide-spread sheet of ice and snow of great thickness, as at the present day is Northern Greenland, where there may be seen an interminable glacier, extending league upon league, broken only by some black hill top or mountain peak that rises as an island above the sea of ice. But there this vast sheet is ever, even while being replenished by fresh falls of snow, slowly and persistently flowing, or rather creeping, down to the sea, covering the face of the country, filling up the valleys, mounting over the hills, and pressing with constant resistless force upon all the rocks over which it advances; and blocks of stone, either loosened from the mountain by frost, or torn off by the moving glacier, are jammed in in the rear, and pressed along the rocky bed or sides of the valley; and the stones, mud, gravel, and sand thus borne along act like files scratching and scoring the hardest rocks, and being themselves scratched by the same process. As it is now in North Greenland so must it have been during the glacial period in Scotland. There we find the rounded, filed down projections on the mountain top and on the mountain sides, and the parallel *striae.* So must it have been at the same period, and on to a later time, in Norway; and thus many numerous phenomena presented by the mountains and the rocks there be satisfactorily accounted for; and to the same operation may be attri-

buted the similar phenomena presented by the mountains and rocks in Finland to which reference has been made.

With ice as with water, notwithstanding its hardness and its tenacity, it seeks the lowest level to which it can attain, and the glacier is ever in a state of flux from the land towards the lower level of the sea, and on its advance grinding away, smoothing, and striating the surface of the rocks, past which, or over which, it flows. The pressure, and consequent abrading power of a glacier must be tremendous. The *vis a tergo* being such that it treats as mere peebles in its path ridges, and even hills of considerable elevation, and seems to pass as easily over them as a deep river flows over the stones that may be in its channel.

And thus may be accounted for the numerous lakes existing in the land, giving to its character and poetic designation, and the existence of the lakes so abounding in Norway and in Sweden.

In the *Quarterly Journal of the Geological Society*, vol. xviii., p. 185, in a paper by Professor (now Sir Andrew) Ramsay, entitled 'The Physical Geology and Geography of Great Britain,' may be found the first suggestion, and illustration, and proof of this fact. There 'he has shown that the innumerable rock-enclosed basins of the Northern hemisphere do not lie in gaping fissures, produced by underground disturbance, nor in areas of special subsidence, nor in synclinal folds of the strata, but that they are true hollows of erosion.'

I cite the statement of Professor Geikie, in his 'Scenery of Scotland, viewed in connection with its Physical Geography;' and to this work I am indebted for the following illustrations:—

'Lakes, at least those which mottle the surface of Scotland, may be grouped into three classes: 1st, those which lie in original hollows of the superficial drifts; 2d, those which have been formed by a bar of drift across a valley or depression; 3d, those which lie in a basin-shaped cavity of solid rock.'

Lakes of each of these kinds may be seen in Scandinavia and Finland. It is in regard to the formation of the last description of lakes that there is any difficulty, the formation of a cup-like hollow in solid rocks, sometimes along the line of a valley, sometimes on a plateau, sometimes on a hill top, or on a watershed.

There are in many rivers deep holes. At the Cape of Good Hope one hears constantly of *See-Koo vleys,* or hippopotamus holes, and occasionally, even in the rocky bed of a river, we find cylindrical cavities called pot-holes. In the bottom of such are generally found a few well-rounded pebbles and boulders. The cavities are due to the circular movements of these or other stones and boulders, which, caught by an eddy, have been kept whirling there, and by friction abrading the rock they have gradually formed, these holes working downward into the solid rock. And often on the sea-shore may be seen cavities lined with sea-weed and filled with sea-water, each a natural aquarium. Some of these are formed, as are the pot-holes, by boulders lying in their bottom which have been kept whirling round in the eddies of a vexed tideway instead of a rapid brook or river.

But it is not thus that these rock lakes have been formed. Of the theory of Professor Ramsay the following illustration is supplied by Professor Geikie:—'A river of ice is not bound by the same restraints as those which determine the action of a river of water. When a glacier is, as it were, choked by the narrowing of its valley, the ice actually rises. In such places there is necessarily an enormous amount of pressure, the ice is broken into yawning crevices, and the solid rocks suffer a proportionate abrasion. The increased thickness of the mass of ice at these points must augment the vertical pressure, and give rise to a greater scooping of the bed of the glacier. If this state of things lasts, it is plain that a hollow or basin will be here ground out of the rock, and that once formed, there will always be a tendency to preserve it during the general lowering of the bottom

of the valley. On the retreat of the ice, owing to climatal changes, this hollow, unless previously choked up with sand and stones, will be filled with water, and form a lake. It will be a true rock basin, with ice-worn surfaces around its lip, and over its sides and bottom.

'And such is the appearance presented by many a lake and tarn in the Highlands of Scotland. One of the largest and noblest of the whole—Loch Awe—may be taken as an illustrative example.'

Nor is it only the formation of single lakes which can be thus accounted for; a continuous succession of lakes in the direction of the movement of the glacier may be thus produced.

As popular illustrations of the mode of operation I may cite the following:—Young boys, and girls too, amuse themselves making what they call 'ducks and drakes' by throwing flat stones across a placid sheet of water, as nearly parallel to the surface of it as they can, causing them to skim along and above the water, touching and rising again and again, rebounding in ever-diminishing bounds till they sink. The same phenomenon may be seen on a larger scale in the recochetting of a cannon ball fired at a target out at sea; and the same thing may be seen in the effects of the wind striking the surface of the water in a river, in a lake, or in the sea, for rarely, if ever, does it blow horizontally or parallel to the surface of the water. Where it impinges it raises a little wavelet, and rebounds, but only to strike again a little in advance, again and again to rebound, producing a succession of advancing elevations and depressions. In another volume entitled *Forests and Moisture*,* I have had occasion to refer to another

* *Forests and Moisture;* or, Effects of Forests on Humidity of Climate. In which are given details of phenomena of vegetation on which the meteorological effects of forests affecting the humidity of climate depend,—of the effects of forests on the humidity of the atmosphere, on the humidity of the ground, on marshes, on the moisture of a wide expanse of country, on the local rainfall, and on rivers,—and of the correspondence between the distribution of the rainfall and of forests,—the measure of correspondence between the rainfall and that of forests,—the distribution of the rainfall dependent on geographical position, determined by the contour of a country,—the distribution of forests affected by the distribution of the rainfall,—and the local effects of forests on the distribution of the rainfall within the forest district.—Edinburgh: Oliver and Boyd. London: Simpkin, Marshall, & Co. 1877.

and different phenomenon occasioned in the same way. It is of frequent occurrence at the Cape of Good Hope, and in local phrase is spoken of as the Devil's Table-Cloth on Table Mountain.

At these times the summit of the mountain is covered with a dense mass of beautiful white fleecy cloud in constant flow over the precipice, and pouring down the almost vertical front of the mountain facing Table Bay as if threatening to bury in an avalanche the capital of the colony at its base; but long ere it reaches the town, notwithstanding the continuous flow, it stops; to that line it flows on continuously, but beyond it not; there the cloud in unceasing flow terminates, the spectator sees not why.

The beautiful and interesting phenomenon is occasioned by a south-east wind, which, up to the Table Mountain range, was undimmed. The wind was strong, but the sky blue and serene, though the wind was loaded with vapour —vapour dissolved and invisible.

But passing over Table Mountain the elevation of this is such that the decrease of temperature, consequent on expansion under diminished pressure, bringing this below the dew-point, the moisture is deposited by the air in the form of a cloud, which, as it reaches at a lower level to leeward, a locality with a higher temperature, the moisture is again absorbed, and the air loaded with it is again transparent, as is all the air around, and as it was itself before passing over Table Mountain in its course.

From Claremont, or Wynberg, or the Flats, or any place to the back of Table Mountain, it may be seen that the cloud is not blown to the mountain, but that there it first appears; and if some few cloudlets, formed over the crests of hills belonging to the range situated to windward, be seen sailing towards it, it is evident that they are 'A sailing, a sailing with the wind,' and not attracted only, for none are seen floating toward the Table-Cloth in other direction than that in which the wind blows.

Of this phenomenon Sir John Herschel writes, 'That the mere self-expansion of the ascending air is sufficient to

cause precipitation of vapour, when abundant, is rendered matter of ocular demonstration in that very striking phenomenon so common at the Cape of Good Hope, where the south or south-easterly wind which sweeps over the Southern Ocean, impinging on the long range of rocks which terminate in the Table Mountain, is thrown up by them, makes a clean sweep over the flat table-land which forms the summit of that mountain (about 3850 feet high), and thence plunges down with the violence of a cataract, clinging close to the mural precipices that form a kind of background to Capetown, which it fills with dust and uproar. A perfectly cloudless sky meanwhile prevails over the town, the sea, and the level country, but the mountain is covered with a dense white cloud, reaching to no great height above its summit, and quite level, which, though evidently swept along by the wind, and hurried furiously over the edge of the precipice, dissolves and completely disappears on a definite level, suggesting the idea (whence it derives its name) of a "Table-Cloth." Occasionally, when the wind is very violent, a ripple is formed on the ærial current, which, by a sort of rebound in the hollow of the amphitheatre in which Capetown stands, is again thrown up, just over the edge of the sea, vertically over the jetty—where we have stood for hours watching a small white cloud in the zenith, a few acres in extent, in violent internal agitation (from the hurricanes of wind blowing through it), yet immovable as if fixed by some spell, the material ever changing, the form and aspect unvarying. The "Table-Cloth" is formed also at the commencement of a "north-wester," but its fringes then descend on the opposite side of the mountain, which is no less precipitous.'

Other illustrations, perhaps more pertinent, are supplied by sand ripples on the shore, and by the contour of sand drifts, while an illustration of reboundings out at sea, like to the ærial rebound described in the passage cited from the writings of Sir John Herschel, are supplied by banks in some of the Argyleshire lochs, which, vertical to

the line of descent of the Highland glen down which in pre-Adamic times poured the glacier which hollowed out the basin. The confining sides of a valley once formed would elongate the furrow or depression thus created in a direct rather than a cross direction. But alternate elevations and depressions, and thus a succession of lakes in the *thalweg* of the glacier, may have been thus produced. The rasping of the ice, charged with fragments of stone, and gravel, and sand, would occasion *striae* and markings on the rocks, and by the direction of these may be traced the direction of the movement, while variations in the direction of these can be accounted for.

The *striae* produced by glaciers are generally apparently parallel and straight The normal ærial currents, popularly known as the 'trade winds,' produced by well known causes, follow a curved direction, throwing off eddies both upward and horizontal. Similar currents and eddies have been observed in the ocean. Like eddies may be seen in the river, and even in the cup of tea, produced by upward currents from the dissolving sugar; and *striae* may be seen following a curve more or less expanding, and more or less contracting, which variation in their direction may have been similarly produced.

Besides the lakes and successions of lakes with which we meet in Finland, there are such moraines as are mentioned in my quotation from Dr Ignatius.

One of the results of the flux of a glacier is the formation of a deposit of stones at the extreme edge of it; stones which have been borne along on its surface, or, it may be, in some cases a little way beneath this by the slow massive advance of the body of ice, on reaching the extremity of it where it is slowly melting away, though continuously replaced, like the lower fringe of the so-called 'Devil's Table-Cloth' on Table Mountain, which has been spoken of, there drop and accumulate. We have had several elevated ranges of great magnitude characterised as such: the *Salpausselkä*, and another further to the north.

It requires sometimes an experienced geologist to judge satisfactorily in regard to such deposits, and determine whether they be the products of glacial or of torrential action. Several discussions relative to the origin of large deposits in France are cited by me in a volume entitled *Réboisement in France** (pp. 101-117, &c.) In regard to the deposits in Finland there is little room for reasonable doubt that they are moraines, and not what in France are designated *lis de dejection* from torrents.

But indications of torrential action also are not awanting in Finland. There, in some cases, water may have only completed what the flux of ice had begun. And it is not improbable that the waterfalls and rapids connecting one lake, or series of lakes, with another, have been brought into their present condition by the action of water bearing along stones—stones both great and small. In reference to what may thus be effected, the writer of the book of Job tells of the waters wearing the stones, of the mountain falling and coming to nought, and of the rock being removed out of its place (chap. xiv. 18-19). In the Vulgate this passage is rendered: 'The mountain crumbling down comes to an end; and the rock is removed from its place; the waters undermine the stones; and by inundation, little by little, the land is laid waste.'

It is matter of common observation that where water dammed up in a hollow makes its escape, this is not done by its pressing away the barrier in its entirety, but by overflowing this it washes away a little of the earth at one or more points on the summit of it; a slightly increased

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* *Réboisement in France;* or, Records of the Re-planting of the Alps, the Cevennes, and the Pyrenees with trees, herbage, and bush, with a view to arresting and preventing the destructive consequences of torrents. In which aré given a *resumé* of Surrel's study of Alpine torrents, and of the literature of France relative to Alpine torrents, and remedial measures which have been proposed for adoption to prevent the disastrous consequences following from them,—translations of documents and enactments, showing what legislative and executive measures have been taken by the Government of France in connection with *réboisement* as a remedial application against destructive torrents,—and details in regard to the past, present, and prospective aspects of the work.—London: Henry S. King & Co. 1876.

flow follows, with increased effect; by a continuation of the process, a cut is sawn, as it were, in the retaining bank with still increasing effects. And as the process goes on, the sides of the channel, which is being formed, are undermined and fall, and the material is swept away by the flow. The erosive power of water is weak, but the erosive power of water charged with solid material is great; and proportioned to this are the effects seen. Water will do little to polish granite, but water and sand will do it; sweet oil will do little to polish steel, but sweet oil charged with emery, or even with rotten-stone, is all-powerful; the wind can do little to polish glass or garnet, but sea-sand, borne onward by the wind, tells upon the hardest rocks, and will polish both glass and gems. And so is it with the water charged with mud, and sand, and gravel, and stones. The sides of the rocky bed of a rapid are undermined and fall; and the swirl of stone-laden water at the foot of a waterfall dashes the force it has obtained against the rock over which it has poured, and undermines and brings down this as well as the confining walls of rock at the sides of the current. At the Falls of Niagara may be seen what may thus be done. Over these Falls pours all the water coming from Lake Superior, Lake Michigan, Lake Huron, and Lake Erie, to Lake Ontaria. The cataract is said to have receded 50 yards since the commencement of the present century. Below the Falls the river flows in a channel which has been thus formed. It extends for miles, is 150 feet deep, and 160 yards, or well nigh 500 feet, wide, and the process is still going on. A remarkable occurrence in connection with this, which occurred within the last five-and-twenty years, was the fall of Table Rock. Of this a contributor to the *Philadelphia Bulletin* wrote:

'I said I had something to do with the fall of Table Rock, that broad shell on the Canada side, which in 1850 looked over the very cauldron of seething waters, but which tumbled in to it on a certain day in the month of June of that, by me, well remembered year. About noon on that day I accompanied a lady from the Clifton House to the

Falls. Arriving at Table Rock, we left our carriage, and as we approached the projecting platform I pointed out to my companion a vast crack or fissure which traversed the entire base of the rock, remarking that it had never appeared to me before. The lady almost shuddered as she looked at it, and, shrinking back, declared that she did not care about going near the edge. "Ah," said I, taking her hand, "you might as well come on, now that you are here. I hardly think the rock will take a notion to fall merely because we are on it."

'The platform jutted from the mainland some sixty feet; but, to give the visitor a still more fearful projection over the raging waters, a wooden bridge, or staging, had been thrust beyond the extreme edge for some ten feet. This terminated in a small box for visitors to stand in, and was kept in its position, and enabled to bear its weight, by a ponderous load of stones heaped upon its inner ends. The day was very bright and hot, and, it being almost lunch time at the hotels, but very few visitors were out, so we occupied the dizzy perch alone. We gazed fearfully out upon the awful waters, we stretched our heads timidly over the frightful depth below, and we felt our natures quail in every fibre by the deafening roar that seemed to saturate us, as it were, with an indefiable dread.

'"This is a terrible place," said I. "Look under there, and see on what a mere shell we stand. For years and years the teeth of the torrent, in that jetting, angry stream, have been gnawing at that hollow, and some day this plane must fall."

'My companion shuddered, and drew herself together in alarm. Our eyes swept the roaring circle of the waters once again; we gazed about in fearful fascination, when suddenly turning our looks upon each other, each recognised a corresponding fear. "I do not like this place," exclaimed I, quickly. "The whole base of this rock is probably disintegrated, and perhaps sits poised in a succession of steps or notches, ready to fall out and topple down at any unusual perturbation. That fissure there

seems to me unusually large to-day. I think we had better leave, for I do not fancy such a finish ! and, besides, my paper must be published next week."

'With these very words—the latter uttered jocosely, though not without alarm—I seized my companion's hand, and, in absolute panic, we fled as fast as our feet could carry us towards what might be called the shore. We first burst into a laugh when we gained the land, and, jumping into our carriage, felt actually as if we had made a fortunate escape. We rolled back towards the Clifton, but, before we had proceeded two minutes on our way, a thundering report, like the explosion of an earthquake, burst upon us, and with a loud roar the ground trembled beneath our wheels. We turned to find that Table Rock had fallen. We were the last upon it, and it was doubtless the unusual perturbation caused by our flying footsteps that disturbed the exactitude of its equilibrium, and threw it from its final poise.

'In a minute more the road was filled with hurrying people, and during the following half-hour we were told a hundred times in advance of the next morning journals, that a lady and gentleman who were on the Table Rock had gone down the Falls. We are told that the trot of a dog would shake old London Bridge from end to end, when it would not be disturbed by the rolling wheels of heavily loaded trains. Table Rock had not been run upon in the way I have been describing for years—perhaps never—and therefore, whenever I hear it spoken of, I always shudder, and feel as if I had something to do with its fall.'

Leaving this to speak for itself, I may state that I have witnessed the effect produced by the fall of this rock, having visited the Falls in 1863, and again in 1873.

In some such way may have been formed the narrow channel through which are poured the waters forming the Falls of Imatra; and thus, also, other water channels in other parts of Finland.

But there may be raised the question, What has become

of all the masses of stone so precipitated into the lower lying channel? In taking this matter into consideration, we are brought upon the consideration of the transporting power of water, which has been previously referred to. The rock, precipitated on to the moving glacier, must move on with the moving mass of ice; and so within certain limits is it with the sand and gravel borne along by a river. Most are familiar with the appearances presented by deposits in a river bed after a flood, which has passed away and left the river bed in many places dry: here shingle, here gravel, here sand. M. Costa de Bastelica, in a work entitled *Rapport au Conseil Federal sur les Torrents des Alpes Suisses Inspectés en* 1858-1863, published at Lausanne, gives some information on this subject. He embodies in his idea of a torrent its bearing along earthy matter in suspension; and he states that it does so both in a mass and in what is known in France as *triage*, dropping some and carrying on others of the materials in question; in the former case all the rocks, pebbles, and lesser fragments are carried along in something like their relative positions, as would be the case in a viscid mass or in a glacier; in the latter the weightier materials are dropped first, and this going on more or less continuously, the matters in a state of extreme comminution are carried furthest. The difference in mode of transport appears in connection with difference in the velocity of the flow. When this is so great as to bear the whole along in a mass, the stones, whatever their size, do not come into collision, and if any were withdrawn they would be found to be as little rounded as are the stones falling from a glacier, and forming a *moraine*.

But when the velocity is being impaired, as this goes on the stones begin to roll, *suspended in the water*, when they may come into collision one with another; and the heavier sinking, these are for a time are rolled along the bottom, and subjected to collision and friction. At length they rest, and where they rest the collision of others following and proceeding further subjects them to continued abrasion;

and what happens thus to the heavier masses happens there or further in advance, in succession as the velocity is reduced, to others of lesser weight.

But he also refers, as have other writers on Alpine torrents, to the more remarkable phenomenon of large stones seen bounding before the advancing wave of a mountain torrent. In regard to this he writes:—'Some of the effects of torrents have appeared so extraordinary that, the the law of torrentiality not having been ascertained, the imagination set to work to seek out fanciful explanations of what was seen.

'Thus, for example, has it been with the general allegation, that at the moment of flood large stones set off of themselves, rolling in advance before the current had touched them, under impulse from a current of air preceding the advancing head of waters.

'Eye-witnesses, and these grave men, have affirmed this fact to myself; and M. Surell has collected numerous testimonies of this phenomenon, and has sought to account for it theoretically. In reality, the fact as reported is absolutely impossible. Resistance increases as the square of the velocity. Let a calculation be made, from the velocity necessary to a current of air to displace a stone no larger than an egg; what velocity would require to be imparted to a current of air capable of displacing a stone such as some of those of which this has been told, which must have been at least 50 centimètres, or 20 inches in diameter! The thing alleged is physically impossible; and it must be remarked that the people who allege they have seen those things occur under their eyes, at a few paces from them, do not dream that if they had been caught in such a current of air they would, at least, have felt it!

'When these witnesses are cross-questioned, they all declare that they have seen the stones rolling dry before them; but no one says he has seen these stones *begin to move*. The witnesses are trustworthy, in so far as it is true that the stones were seen rolling before their eyes;

but the point in which they deceive themselves is the explanation of the phenomenon. They have attributed this to the force of the current of air; and there is the mistake.

'The fact is a very simple one, and easily explained in accordance with what has been evolved by the study of the effect of a sudden retardation on a current of matter. Through the velocity acquired, and the upward direction given to their movement, the stones, detaching themselves, are projected forward from the water by which they were borne along.

'We find that it is towards the contraction of a water-course, occasioned by a bridge, that the phenomenon manifests itself with most intensity. It is, moreover, at such points that it ought to be most easily observed. At the time of a great flood there are few spectators in the deserted gorges of the torrents.

'From the moment that we are in possession of principles, nothing is more easy than to account rationally for all the effects, and all the accidental incidents which they may produce.' Such is the transporting power of water.

In the Falls of Imatra, as in the Falls of Trollhätten in Sweden, and the Falls of Clyde in Scotland, we have what more resembles a rapid than a waterfall, such as it is generally pictured by the imagination. In these it seems that while smaller stones have been carried away, larger ones have been left in the channels, forming an irregular slope from the peaceful rapids above to the peaceful lake below, but the mass of stones which have been carried away must have been enormous, and thus our thoughts again are carried back to the glacial period, and we are prompted to imagine what must have been then the state of things here. Nowadays the flow both at Niagara and at Imatra is comparatively small, but when the formation of these channels was begun, and when the operation was in its early energy it was probably very different. In the case both of the one and of the other there are indications of the depth

of the water having been much greater formerly than it is now; and greater depth in such cases implies greater velocity; and greater velocity implies greater power. From what the flow now is, carrying off only the drainage of the rainfall in the higher lying basin, we may imagine what it must have been, when it was carrying off the meltings under an elevated temperature of glaciers formed of the accumulated snows of the glacial period.

Marine engineers employed in the construction of breakwaters and like undertakings have made us acquainted with the fact of stones tons in weight being displaced and tossed about by the waves during a storm. Here such masses must have been moved by the river's flow; and from this we may again imagine what must have been the mass of waters pouring down from the melting glaciers, and this not by a steady, constant flow, but alternating with this at times another phenomenon of glacial action.

There is a phenomenon well known in Alpine regions: the *débâcle*, or outburst of water resulting from the melting of snow pent up in some secondary valley, to which free passage has been suddenly given by the melting of the icy barrier. A characteristic example is one furnished by the glacier of Giétroz.

At the bottom of the valley of Bagnes, one of the branches of the Drause, at sixteen kilometres, or about twelve miles from Chadles, there rises vertically a high wall of rocks surmounted by the glacier of Giétroz. The moving mass protrudes itself, projects beyond the support, and falls at the foot of the precipice; the broken fragments congeal anew and form a cone-shaped glacier, which pushes before it its moraines. What ensues must be given in the narrative of *Guide Joanne*:—'In those years in which avalanches are very frequent the heat of summer does not suffice to melt a quantity of ice equal to what the mountains cast down. The enormous block which then forms a bridge on the Drause becomes always larger and larger,

and as the arch of this bridge, dug in summer by the torrent, closes up in winter, it happened in 1597, and in our times, in 1818, that the early months of spring sufficed not for the Drause to open for itself a passage, and a lake was formed behind the ice.

'When this became known (wrote M. Simond, some months after the event), alarm spread at once, not only throughout the whole valley but in Le Valais, and on so far as Italy. Travellers feared to take the route of the Simplon; it was felt that when this dyke should come to break up there would be there a sudden débâcle which would sweep over the country to a great distance. The preceding winter had been severe; the ice had even then cast a dam across the valley, but without stopping the water, which had eaten out a passage for itself; but a second severe winter had produced such a fall of ice that the obstacle had become insurmountable and impervious.

'The Government sent an engineer (M. Venetz); he found that the dyke was 110 toises (nearly 700 feet) in length from the one mountain to the other, 66 toises (or about 400 feet) in height, and 500 toises (or 3000 feet) in thickness at its base. The lake was 1200 toises (or upwards of 7000 feet in length, and had already risen to half the height of the dyke, that is to say, was from 30 to 40 toises (from 180 to 240 feet) in depth. The engineer determined to cut a gallery or tunnel through the thickness of the ice, beginning 54 feet above the actual level of the lake, to give time to complete the work before that height should be reached by the accumulating waters, which were rising at the rate of from 1 to 5 feet per day, according to the temperature; and he began the work on the 11th of May at both ends of the tunnel. Fifty men in relays, relieving one another alternately, wrought there night and day at the peril of their lives,—one and another of the avalanches, which were falling every moment, threatening to bury them alive in the tunnel; many were wounded by lumps of ice, or had their feet frozen, and the ice was so hard that it frequently broke the pick-axes

used. In despite of all these difficulties the work advanced rapidly. On the 27th of May a great piece of the dyke broke off from the bottom with a fearful crash; it was believed that the whole was about to break up, or to rise in a mass, and the workmen fled; but soon they courageously resumed their work. Similar accidents occurred repeatedly; some of the floating masses, calculating from the distance at which they stood above water, must have had a thickness of 70 feet submerged. On the 4th of June the tunnel, 608 feet long, was cut from end to end; but as it had an elevation of twenty feet or more in the centre it was necessary to level it. The weather had been cold, and the lake had not yet risen to the level of the mouth of the tunnel, so they continued to lower this till the 13th, the day on which the flow commenced, at ten o'clock at night. The lake still rose for some hours; but next day at five o'clock in the afternoon it had sunk 1 foot; on the morning of the 15th, 10 feet; on the morning of the 16th, 30 feet; at two o'clock that day the length of the lake had shrunk 325 toises (nearly 2000 feet), for the tunnel, being continually eaten away, lowered itself as quickly as the lake. The Drause flowed, filled from bank to bank, but without overflowing, and a few days more would have sufficed to empty the immense reservoir.

'But detonations in the interior of the dyke announced that *glaçions*, blocks and pillars of ice, were detaching themselves from the mass, through their low specific gravity, and were thus diminishing the thickness of the dyke on the side towards the lake, while the current out of the tunnel was eating away this dyke on the outer side, and was threatening a sudden rupture; the danger increasing, the engineer despatched from time to time expresses to warn the inhabitants to keep themselves on the look-out. The water began to make way under the ice, sweeping along the stones and earth at its base under the tunnel; the crisis appeared inevitable and close at hand. At half-past four o'clock in the afternoon a tremendous crash announced the rupture of the ice-work; the water of the lake shot

along with fury indescribable; it formed a torrent 100 feet in height, which traversed the first 6 leagues, or 18 miles, in forty minutes, although kept back in many places by narrow gorges through which it had to pass, carrying off in its course 130 chalets or cottages, a whole forest, and an immense quantity of earth and of stones. Debouching over against Chables, the chief place of the valley, the water was seen pushing before it a moving mountain of all kinds of *débris* of 300 feet in height, from which was rising a thick black cloud like the smoke of a conflagration. An English traveller, Mr P., of Lausanne, accompanied by a young artist, and a guide, was returning from seeing the works, and going towards Chables; happening by chance to turn round, he saw advancing with fearful rapidity the moving column, the distant roar of which he had not heard through the noise made by the Drause. He hastily warned his two companions and three other travellers who had joined them; all leapt from their mules, scrambled up the mountains, and got safely beyond the sweep of the deluge, which filled in an instant the whole gorge beneath them. But Mr P. was nowhere to be seen; for some hours they believed him to be lost; but then they learned that his mule, shying at an overturned tree which she saw on the road, wheeling round, saw all at once an object far more dreadful close upon her, and, darting off towards the mountain, had carried him far away from the scene of danger.

'From Chables the débâcle arrived at Martingy--4 leagues, or 12 miles distant—in 50 minutes, carrying off, as it advanced, 35 houses, 8 mills, 95 barns, but only 9 people, and no cattle, the inhabitants having all been warned to be on guard. The village of Bovernier was saved by a jutting rock turning off the flow of the torrent; and the people saw it pass like a shot by the side of the village without touching it, although much higher than their heads. The rocks and stones were dropped before it arrived at Martigny, blasting with sterility extensive meadows and fertile fields.

'There it divided, but 800 of the houses of this town were carried away, many others were damaged, and the streets were strewn with trees and earthen *débris;* 34 people only appear to have lost their lives there, the inhabitants having betaken themselves to the mountains.

'Below Martigny, the débâcle, finding a great plain, spread itself out and deposited a great deal of mud and wood, and that to such an extent as to render healthful, as was hoped, a great marsh there. The Rhone received it little by little, and at different parts of its course, without overflowing; it reached the Lake of Geneva at eleven o'clock at night, and was lost in the great extent of that lake, having traversed a course of 18 leagues, or upwards of 50 miles, through Switzerland, in six hours and a half, by a movement gradually retarded.

'All the bridges having been carried away, the inhabitants on the two sides of the Drause could have no communication for some days, or inform one another of their respective losses, but by throwing across the river notes attached to stones; and the putrifying slime threatened them with an epidemic. It is somewhat remarkable that an old man of ninety-two saved himself by getting on a hillock supposed to have been formed by a débâcle in ancient times; the new one followed him to the very summit, where he maintained his footing by the aid of a tree which was not carried away.

'M. Escher estimated at *eight hundred millions* of cubic feet the mass of water which had accumulated at the time it began to flow out by the tunnel. This mass had been reduced to *five hundred and thirty millions* in the course of the three days following, and the level of the lake was lowered by 45 feet. If the tunnel had not been made the lake would have risen 50 feet higher, and the mass of water would have attained a measurement of *seventeen hundred and fifty millions* of cubic feet when it began to flow over the dyke, instead of the *five hundred and thirty millions* to which it had been reduced when it began to pass across the tunnel, and would have spread its ravages over the whole of the lower Valais.'

Imagine a débâcle of a magnitude such as would correspond to the size of the glaciers of those times, and the rapidity of its flow, and we shall not wonder that stones which might have seemed to us to have been immovable because of their size and weight, have been carried away and buried in some lower-lying lake. In this then, as well as in the *striae* on the rocks, we may see the traces of the glacial period, the effects of glacial action.

Of the vast extent of the glacier covering Scandinavia and Northern Russia at that time, under one sheet of ice, it is difficult for the novice in the study of such phenomena to form an adequate conception.

Christiansand stands upon ice-ground rocks. All the islands for miles out to sea are what are known as *roches moutonnées,* peering above the waves. The road leads inland through a wild pass, with hills on either side, with dark pines growing in chinks on the grey rock, and the bottom of the pass is filled with a plain of boulders and sand, which look as if ice had dropped them yesterday. Throughout Norway and Sweden, and I may say the whole north of Europe, boulders abound, and zircon syenite found as fixt rock near Christiansand has both been found in Lapland as a perched block, and in pieces of lesser bulk at Galloway in Scotland, and thus we are led to the consideration of another aspect of the case.

The author of *Frost and Fire* has traced the *striae* in several valley lines in Scotland. And in allusion to the views advanced by Professor Ramsay, and reargued by Professor Geikie, he says—'Mr Ramsay attributes many rock basins and their lakes to glaciation, and intimates that he goes further and attributes these, and many of the main lines of denudation in Northern Europe, in North America, and elsewhere, to glaciaton, *combined with ocean currents.*'

Both in Scotland and in Scandinavia he gave unwearied attention to the *striae* and their conformation in accordance with the movement of waves, which he had made a special

study, together with the production of these by heat, and by enervated obstacles.

And he writes, 'After thus crossing the trough in which the Baltic lies at six different points; after travelling round the whole peninsula, and crossing the isthmus; after taking a peep at the Russian side, fishing, and copying rock forms everywhere, a glacial theory had formed insensibly. Either the hills of Sweden had been covered with land glaciers, which made one big glacier in the Baltic, or the hills were so covered, and the sea was up to their bases, and loaded with ice-floats which moved down the Baltic, over Southern Sweden, and into the German Ocean. In any case numerous ice-grooves point across the road, and along the coast-line, instead of pointing up at the mountains, which they would do if made by glaciers like those on the Alps.'

Writing of Trollhättan he says, 'It is a large water slide—a slide not a fall, and the rocks beside it are striated. Large lakes, through which the steamer passes, are full of great stones, some of which are balanced upon the backs of rocks, and rise above water; others are piled in heaps, which form circular islands, long mounds and long shallow channels through which the steamer is guided by poles stuck up for beacons. All the rocks seen were of ice-ground forms, but land glaciers will not account for them.

'Any good map will show that all the chief rock-basins and rock-grooves in Sweden, between lat. 60° and 56° N.; all the chief lakes, and chains of lakes, and most of the large rivers, and main roads (which are made in hollows), point N.E. and N.N.E., up into the Baltic, and at the isthmus which cuts the Baltic from the Polar basin. Nothing here points at the hills.

'The shape of the Baltic, its coast forms—fjords and islands—are copies of the lakes. There are the same rocks, the same circular islands, the same low hills, fading away into a blue sea, in which the same roads fringe a tideless coast. The maps show the same physical

geography. The shapes of Gottland and Oland are like the Wenern and Wettern lakes: the main coast lines from Stockholm to Carlskroner cut Meridians diagonally as the lakes do. These lines have reference not to the hills but to the coast.

'At Stockholm oaks flourish on ice-ground rocks—ice-grooves abound but they do not point at the nearest hills.

'The coast up to Umea is a copy of the coast below Stockholm. Many islands in the gulf are piles of boulders, half in, half out, of the water, and all the rocks, without exception, are like low islands on the opposite Norwegian coast, which are all of one pattern.'

At a subsequent date he adds, 'On the 25th of July crossed the gulf to Wasa in Finland.

'The country and the people on the Russian side seem to be identical with Sweden and Swedes. Lakes, trees, rocks, and large wandering stones characterised both sides. I could not find *striae* that indicated the direction in which ice had last moved over these rocks; but the grinding-engine did not seem to have moved from the opposite mountains of Scandinavia.'

From this it will be seen that he was disposed to suppose that the ice marks in Finland may be attributable to floating ice.

In reference to high land in Norway, it is said by him:

'Taking the Fjærland glacier as a small working example of a local ice-system, easily visited and easily understood, the larger system from which it falls is comprehensible; and neighbouring systems are found to work on one plan. Starting from marks which are under moving ice, near Bergen, they lead to a large local system in Southern Norway, and to one still larger which covered the southern half of the peninsula below lat. 64°, and cumbered the Baltic and North Sea with floating ice. The very same forces—heat and weight, move these land-ice systems now that they are little, that moved them when they were big.

'The lesson taught by these two blocks of high land in

Southern Scandinavia is that two kinds of ice-marks remain on this part of the Northern Hemisphere. There are marks of local ice-systems which radiated from the watershed. There are also marks on watersheds and high passes; and on lower lands at 3000, 2000, and 500 feet, which do not radiate from any watershed, but point N.E. and S.W., or thereby. Take the northern block of the peninsula, and the same thing appears.'

CHAPTER III.

FLORA.

Section A.—Indigenous Plants.

Much which might have found an appropriate place here has been brought under consideration in information supplied in regard to forests and forest trees; but here a more general, and at the same time, a more comprehensive aspect of the subject is brought before us.

The flora of Finland, and especially that of the eastern portion and of the interior of the country, Dr Helms says has not yet been thoroughly studied, and there are many interesting phenomena which it presents. For example, plants grow in the southern districts which are not found in the midland districts, but which are suddenly again met with in the high northern latitudes, for which, says he, no satisfactory reason has yet been assigned.

Scandinavia, he goes on to say, is indebted in a great measure to its hills and rocks for the variety seen in its flora. From her mountain ranges branch off lesser spurs extending through the coast districts, and determining the watersheds, and bordering the rivers and streams. The vegetation of the hills, of the valleys, and of the coast, is in consequence of this, and that more especially in Sweden, constantly changing. Finland, and more especially its western coast lands, which are those nearest to Sweden, does not present the same variety.

In North-Eastern Finland, where the rocky regions may be said to commence, the vegetable world exists only as in a death struggle for existence. These circumstances, and the further extension of the Scandinavian peninsula from

the north southwards beyond the southern limits of Finland bring about this difference. While the Swedish flora numbers some 2330 different kinds of plants—one half phanerogamic, the other half cryptogams—the Finnish flora numbers only some 900 of each, or 1800 in all.

But Dr Ignatius, Director of the Bureau of Statistics, reported in 1878 :—'The Finnish flora at the present time comprises 1080 phanerogamic, and 1800 cryptogamic plants, without reckoning the fungi, which of themselves exhibit as many species as all the other cryptograms together.'

'It is interesting,' writes Dr Helms, 'to pass by slow degrees from death to life, commencing in the extreme north-west with the observation of the first indications of organic life within the Polar Circle, and tracing its successive manifestations till its ever-increasing power of production is seen towards the southern coast of Finland and its granitic island archipelago. In the extreme north, on the waste steppes, through which flows the Tama, it is with great effort apparently that Nature produces a somewhat crippled and deformed vegetation. The appearance of the country is saddening in the extreme. The dwarf birch and the juniper, with the reindeer moss, clothe but sparingly the sunny side of the rocks and hills, and a sickly *tanne* or fir tree stands here and there in a mountain kloof. Further on we come upon valleys, to which the sharp cutting wind cannot gain access. Here the blackthorn, the sweet briar, and the aspen expand and develope their leaves with astounding rapidity under the glowing sun of the month of June, and are seen embosomed in a grass of wonderful length growing on the river banks. To the south of Utsjoki the pine and the fir, and about the same latitude also the mountain ash, begin gradually to make their appearance, and with these the list of the more common kinds of trees found in Finland may be considered complete. But pretty far to the north of this the berry-bearing bushes of the country, such as the blaeberry, the

brusnika, the cranberry, and the like are found. In the neighbourhood of the Enare Lake the trees and plants show a prouder bearing. Here may be seen one of the first of the forests, but agriculture scarcely yet appears, only potatoes, cabbages, and turnips are raised as a kind of experiment in the garden attached to the parsonage at Utsjoki, Corn crops ripen where the Ivolajoki flows into the Enare, rye and hemp in Muenioniska. In Uleaborg the apple-tree produces blossoms but no fruit, excepting in Ny-Carleby. Above Gammal-Garleby oats ripen, and root crops are pretty generally cultivated. Flax grows, but it is rather coarse, in the northern part of Wasa län or county, but it does not grow well further to the north. Wheat flourishes around Abo, pease in Tavastland, hops in Wasa län. Tobacco will grow in the midland of Oster-botten, and over the whole land in the south, but it is little cultivated. Of trees growing in the south, the willow grows further to the north than it does in Sweden, but the ash not so far to the north as it does there. The oak is rarely found beyond 61° N. lat., and it appears manifestly to have shrunk within its northern limits in the course of the last century. The lime-tree grows wild in the south-east of Oster-botten ; further to the north it grows only exceptionally, and there it must be planted artificially. Alders are met with first scattered over Tavastland. They flourish also in Wasa, where also cherries ripen.

'The stiff high-stemmed *Fichte*, or pines, are one of the most important sources of income for Finland, and also the *Tanne* (firs) lend to the forests of the land a stern and a somewhat sullen character even in the middle of summer when one passes into them from blue lakes and the bright green grass carpeted meadows. A more cheerful aspect is presented by the forests in winter, when the never-failing green of the conifers contrasts pleasantly with the white snow coverlet of the ground, and the fresh scent of the fir trees ever reminds one of the undying youth of Nature herself, during what may be called her winter sleep. To

journey in a light sledge, with tinkling bells, through some such scented, dark-green and snow-white forest, while the stars and the Northern streamers glimmer overhead, has for the spirit what is in the highest degree refreshing.

'The Northern people have a deep feeling of this, and understand it well, and even the Laplander looks from under a mild heaven to the snow and the rocks, and sighs after the peaceful enjoyment of his waste-lying steppes. The Southerner, on the other hand, who for the first time visits the great coniferous forests of the interior of Finland, feels himself saddened under their stern aspect. It is not the absence of the soft green in the beautiful display of colour with which the forests in the south adorn themselves, and which the broad-leaved woods of Finland are only in a position weakly to sigh after,—it is not the deep shadows and the moist coolness which awakens this feeling in him against his will; but it is the perfect stillness which gives them the stern aspect that does it; but this awe-producing silence of the wilderness does not the less fascinate and surprise him.

'Nine months long lasts this solemn stern silence of Nature. It is as if the wild beasts were afraid to desecrate the stillness by their noise: only rarely, as if restrained, sounds the howl of the hungry wolf, or the cry of some solitary bird of prey, while here and there only a heathcock flies out from the wood, and a sneaky fox steals about between the wood pile and the charcoal burner's hut.

'But during the three months which follow this time of stillness, and in which the life of the north awakes from its winter sleep, from the the middle of April to the middle of July—the glorious time of light in which Nature knows no more of night—the solitude of the forest awakes to life, the song of birds is silenced neither by day nor by night, and if there be no hare frightened by the cry of the dogs hastening on fleet-foot through forest and field, there is no wood or bush so small or so destroyed but the hare is racing through it, and no forest

lake so concealed but geese and ducks have chosen it for their home, and found there a free dwelling place.'

Everywhere throughout the districts which I traversed I found the mounds, and hillocks, and hills, covered with wood—most commonly young wood. I would scarcely be warranted to call it coppice, but it was yielding firewood and not timber.

Excepting in the extreme north, and there only to a limited extent, are there any districts which can be characterised as treeless. The region through which I passed, and that along a great deal of the west coast, are deficient in timber trees, but trees producing firewood are not awanting. More inland on the west coast between the littoral land and that of the lake district which I visited at this time, there is a deficiency of timber trees, and the little firewood there is, is comparatively worthless. But in the higher lying land, from 200 to 400 feet above the level of the sea, both firewood and timber trees are abundant.

Of the land thus wooded there are:—

Of the last mentioned, -	15,785,000	tunnland.
Of the first mentioned, -	16,759,000	,,
Of the second, - -	9,456,000	,,
In all, - -	42,000,000	,,

Following the course of rivers all along the coast from St. Petersburg to Torneo agriculture prevails, and studded over the southern half of the land in innumerable localities it is practised.

It is stated that in Finland there are:—

Of woodlands, - - -	42,000,000	tunnland.
Of land incapable of tillage, -	19,259,132	,,
Of water, - - -	6,115,392	,,
Of meadow land, - -	5,817,270	,,
Carried forward,	73,191,794	,,

Brought forward,	73,191,794	tunnland,
Of arable land, - - -	1,690,822	,,
Of rocky land and roads, -	99,696	,,
Total,	74,982,312	,,

The mean temperature at Hango, the most southern part of Finland, is 5° Celsius, lat. 62°, the northern limit of the satisfactory culture of wheat. The mean temperature is 3° lat. 64°, is the northern limit *arter* (legimumes), and half a degree to the north of this is that of oats. The mean temperature in this region is 2°. In 65.50, is that of hemp. The mean temperature here is 1°. From 67° east, to 68° on the coast, is that of rye About and in 69° that of barley. Here the mean temperature is 0°.

Between latitude 60° and 62° there occur in the following order the northern limits of the trees named:—the oak, the ash, the hazel, the maple, and the elm; between 62° and 64° those of the lime and the mountain ash; about 65° that of the elder; about 68° that of the aspen; and between 68° and 70° those of the spruce, the pine, and the birch.

In a Finnish Atlas of physical geography, *Sounenmaan Kastasto Kouleyen Tarpeeksi Tehuyt Vuonua*, 1878, by I. J. Inberg, are supplied indications of these and numerous other matters pertaining to the physical geography of the country, and several similiar maps are appended to statistical notices, prepared in view of the Paris Exhibition of 1878 by Dr Ignatius, and published at the expense of the Finnish Government. Amongst others, one representing the limits toward the north, to which some twenty-eight vegetables extend in Finland, the range of them growing wild is given in one colour, the range of the same or others growing under cultivation is given in a different colour. When the northern limits of a plant differs in the east and in the west of the country, or is only known at isolated localities, these are indicated by points, under which is stated the corresponding longitude reckoned

from Ferro. And the isotherms for the years 1873-1875 are indicated from 5° to zero.

Section B.—Exotic Trees and Shrubs.

Besides trees indigenous in Finland, there are cultivated several which have been introduced from abroad. Amongst these is the Siberian fir, or pitch pine, *Abies sibirica* Led., *Pinus pikhta*, Fisch. Planted in some parks in the southern part of the country, this tree has exhibited so favourable a growth as to lead to its being considered deserving of cultivation in the forests; and some experiments of this on a small scale have been made at Evois.

The Siberian Cembrian pine (*Pinus cembra sibirica*) has been of late years cultivated here and there up to 67° in the valley of the river Tornea.

The Weymouth pine (*Pinus strobus* L.) grows well up to 63°, near the west coast at Wasa, but it does not appear to succeed in the interior of the country to a higher latitude than the vicinage of 61°.

The Balm of Gilead (*Abies balsamea* Mill.) flourishes up to 61° 53′.

The silver fir (*Abies pectinata* D.C.) suffers even on the south coast as at Helsingfors, where it attains but little height, or more properly it may be said it becomes stunted in its growth.

The white fir (*Abies alba* Michx.) thrives in the vicinage of 60°.

The American arbor vitæ (*Thuja occidentalis* L.) is found on the western coast as far as 63°, but in the interior of the country not beyond 61°. It is but little cultivated. But on the west coast, where the limits of vegetables towards the north reach in general to a higher latitude than in the interior of the country, it has been cultivated successfully so far north as Tornea 65° 51′.

The lilac (*Syringa vulgaris* L.), the Siberian pea-tree (*Caragana arborescens* L.), and the Tartarian honeysuckle

(*Lonicera tartarica* L.), have been cultivated at Uleaborg 65_0 1′.

The willow-leaved spiræa (*Spiræa salicifolia* L.), the rowan-leaved spiræa (*Spiræa sorbifolia* L.), the flowering bramble (*Rubus oderatus* L.), the barberry (*Berberis vulgaris* L.), the snowberry (*Symphoricarpus racemosus* Michx.), and the red berried elder (*Sambucus racemosa* L.), have been cultivated at Ny-Karleby, 63° 23′, and at Jakobstad, 63° 40′; the tacamahac (*Populus balsamifera* L.), the abele tree (*Populus alba* L.), and the perfoliate honeysuckle (*Lonicera caprifolium* L.), have been cultivated at Björneborg, 51° 30′. The hazel (*Corylus avellana* L.) is found on the west up to 61° 40′, on the east to 61° 80′. On the south and south-east coast it is very common; and so is the horse chestnut (*Æsculus hippocastanum* L.), but this does not appear to bear the climate north of 61°.

These shrubs and trees are species which it has been tried to cultivate throughout almost the whole country, even in gardens of limited extent. A great many other species besides these are to be found in gardens of greater extent and in parks; but this most frequently in the southern parts of the country.

Amongst rarer kinds may be mentioned the butter nut (*Juglaus cinerea* L.), which has been cultivated at Eriksnäs, in the parish of Sibbo, 60° 17′, for so long a time that a tree produced from seed of one of the older trees has had time to attain a height of 30 feet; of the walnut (*Juglans vegia* L.), at Svarta, parish of Karis, 60° 8′, there is a tree 15 feet in height; the hornbeam (*Carpinus betula*) is grown at Fiskars, parish of Pojo, 60° 8′; tho beech (*Fagus silvatica* L.), cultivated in some places in the south in Finland, appears to have attained at Fagervik, 60° 2′, the dimensions of a small tree; the most northern place in which it has been cultivated is Frugärd, about 60° 30′. Planted there about a hundred years ago, it has continued to grow till now, but it is only a shrub a few feet in height.

Sections of many of these different kinds of cultivated forest trees and shrubs were exhibited at Moscow, a great many of them being supplied by Mr E. de Julin, proprietor of the works at Fiskars, which speaks the interest taken by him in the culture of trees.

Of forest trees acclimatised in Finland, and very widely dispersed, may be cited the following: the apple (*Pyrus malus*), which in the south yields pretty good fruit, but it does not succeed well to the north of 62o lat., and in 63o the fruit ripens only in good years. There may be seen at Uleaborg and at Tornea dwarf apple trees, but they do not fruit.

The pear (*Pyrus communis*) is pretty common in the south of the Governments of Abo and of Nyland, but it becomes rare, and ceases to fruit every year from 61° northward.

Two varieties of the cherry, the common cherry (*Prunus cerastus*), and the bird cherry (*P. avium*), are met with, the former so far north as the environs of Wasa and of Kuopio, and the latter up to 61° north.

The bullace tree, or wild plum (*Prunus institia*), and the common plum (*P. domestica*) have the same limits, the former that of the cherry, the latter that of the gean.

The rough and the smooth gooseberries (*Ribes grossularia* and *R. uva-crispa*) succeed very well at Wasa and Kuopio. There are cultivated also in the gardens varieties of the gooseberry, of the black currant, and of the rasp. As for apricots, and peaches, and grapes, they are only to be had imported.

There are found throughout Finland in great abundance berry-bearing plants such as the whortleberry (*Vaccinum myrtillus*), the cowberry (*V. vitis idæa*), the cranberry (*V. xycocus*), and the cloudberry (*Rubus chamaemorus*). The dwarf crimson bramble (*Rubus articus*) is everywhere abundant between the Arctic Circle and the 63° parallel. The strawberry (*Fragaria vesca*) is widely diffused in the

south of the country, but becomes more rare as we advance to the north, and disappears entirely in Lapland. Other plants of this kind are the blaeberry (*Vaccinum uliginosum*) and the stone bramble (*Rubus saxatile*) which are less nice in choice of habitat.

CHAPTER IV.

FAUNA.

Section A.—Indigenous and Domestic Animals.

By Dr. Ignatius it is reported that it is not yet practicable to state precisely the number of species of animals to be found in Finland, for many classes of moluscs and zoophytes have not been sufficiently studied.

Amongst the vertebrates there have been reckoned about 60 species of mamifers, including domestic animals and acclimatised species. Of these the more remarkable are the following:—

The bear (*Ursus arctos*) is met with throughout the whole of Finland up to the north of the Enare Lake, where the forests being thinly sown, the ants more rare, and the berries in less abundance, food fails it. It lives chiefly in ferny lands covered with thick forests.

The wolf (*Canis lupus*) is found to the boundary north of Lapland; it commits great devastations, especially during severe winters, when it penetrates in great herds to the vicinity of the habitations of men.

The fox (*Canis vulpes*) is spread over the whole land; the *croisé* fox and the black fox are rare varieties, sought after for their valuable furs.

The isates (*Canis Lagopus*) belongs, strictly speaking, to Lapland, but it is met with sometimes even in the south of Finland, particularly in severe winters.

The beaver (*Castor fiber*) likewise belongs to the far north. For two centuries past the hunters have killed hundreds annually, but it has become so rare, that it is not known for a certainty still to exist in Finland.

The elk (*Cervus alce*) is a beautiful animal which is tending to disappear. In despite of the existing regulations, which absolutely prohibit the hunting of the elk, they are still killed every year.

The hare (*Lepus timidus* and *L. europaeus*), and the squirrel (*Sciurus vulgaris*), are sought after for their fur.

There are found along the coasts of the Gulfs of Finland and Bothnia seals (*Phoca vitulina* and *P. Hispida*), and what is somewhat remarkable, this last is found also in Lake Ladoga and the Saima See. Amongst noxious animals are the black rat (*Mus ratus*), which, however, is apparently gradually disappearing before the brown rat (*Mus decumanus*), and the mouse (*M. muscatus*), &c. The field-mouse (*Arvicola agrestis*) occasions much damage to the fields and meadows to the south of the country, but more injurious still is its Lappish congener *A. ratticeps* which desolates the fields of potatoes and barley of the colonists in Lapland.

Amongst domestic animals may be mentioned the horse (*Equus cabalus*), in general small, seldom exceeding 1·34 metre, but well made, strong, and enduring: Finnish horses have come into general use on the tramways of St. Petersburg. The ox (*Bos taurus*), the sheep (*Ovis aries*)—a small race, with coarse wool; the goat (*Capra hircus*), the hog (*Sus scrofa*), the dog (*Canis familiaris*), the cat (*Felis domesticus*), and lastly the reindeer (*Cervus taurandus*) in Lapland and in Finland to the north of lat. 65° 30′. It exists also in a wild state on the northern slopes of the Maanselkä.

Of birds 211 wild species are known, besides 6 domestic species. Near inhabited parts of the forests, these are full of singing birds. The nightingale (*Luscinia major* var. *Philomela*) is met with in the south-east part of the country, but not to the west of Helsingfors, nor to the north of Kuopio. On the other hand, the lark (*Alauda arvensis*), the thrush (*Turdus musicus*), and many species of sylphides or warblers are common throughout the whole country. The greater part of these birds emigrate in

autumn, as does also the swan (*Cygnus musicus*), which may be seen in summer for a very short time swimming in the lakes of the north and the north-east.

Of feathered game may be mentioned the woodcock (*Tetrao bonasia*), the heathcock (*Tetrao urvgallus*), the small grouse (*Tetrao tetrix*), the gray partridge (*Perdix cinerea*), the *Lagopus alpinus*, and many species of wild ducks.

There are also birds of prey in great numbers. Amongst others there are the common eagle (*Aquila chrysaëtos*), the osprey (*Haliaëtus albicilla*), this latter, however, migrates in winter; six species of falcons, two of vultures, and six of owls.

Of fish there are found in the lakes, and rivers, and seas around Finland, some 80 species. Amongst the most important, in an economical point of view, are the herring (*Clupea marengus*), from 75 to 100 millimetres in length, which frequents the Gulfs of Finland and Bothnia, and is met with on extensive banks near the outer reefs of the archipelago of the coast; the anchovy (*Clupva sprattus*, L.), common on the south and south-west coasts; the pike (*Esox lucius*), abounding in all the Finnish waters, and on into Lapland; the perch (*Perca fluviatilis*), which is also common like the last; the sandre (*Lucioperca sandra*, Cuv.), is met with up to 66° 5′ in the greater part of the deep lakes, and also in the archipelago in the south; the *Platessa flesus*, L.; the cod (*Gadus morrhua*, L.), common in the Gulfs of Finland and Bothnia, up to Qvarken, but rare to the north of this; the *Lota vulgaris*, Cuv.), which is taken everywhere in winter; the eel (*Anguilla vulgaris*, Flem.), which is fished in the sea, and in most of the rivers and lakes in communication with it; the bream (*Abramis brama*, L.,) is met with up to the Polar Circle; the *Idus melanotus;* the roach (*Leuciscus rutilis*); many species of the genus lavaret (*Coregonus lavaretus*, L.), *Marocna block*, &c.; the *Coregonus albulal* L. is limited in its longitudinal range, but it

is so abundant in the lakes that it constitutes an important portion of the food of the people in the interior; the salmon (*Salmo salar*, L.), and the trout (*Salmo trutta*), constitute the subject of a very important fishing in the larger rivers; and there are found singular varieties in the Ladoga—*Salmo relicta*, Malmgr., and in the other large large lakes of the country *Salmo lacustris* L.; the river lamprey (*Petromyzon fluvialis*), &c.

Of reptiles there are reckoned five species, of which one only is venomous, the common viper (*Pelias herus*, L.), which prefers stony slopes exposed to the south, but which is also found in the land and in the forests. It is met with also in the south of Lapland.

The *Amphibia* are also represented by five species. Two species of frog—*Rana temporaria*, L. and *R. arvalis*, Nilss.; the toad (*Bufo vulgaris*, L.), the salamander (*Triton palustris*), and the triton (*T. aquaticus*, L).

Amongst other molluscs there is a shell-fish producing pearls, the *Margaritana margaritifera* L., which is found everywhere in the water-courses communicating with the Oulujaervi, and also in the rivers of the south. The *Mytilus edulis* L. is common in the Gulf of Finland and north to Wasa, but it is not eaten, nor are the different species of periwinkle. There has been found in the south of Finland a specimen of the *Helix pomatia*, L., but it is not yet known whether it may be reckoned as belonging to the Finnish fauna.

In notices of the *Articulata* it may be mentioned that apiculture is somewhat extensively carried on in the south, especially in the Governments of Abo and Bjorneborg. The caterpillar of the *Noctua Graminis*, L. occasions great devastations, and in some years almost entirely destroys the meadows in some places. The forests of conifers are sometimes attacked by varieties of the *Hylastes Scolytus*,

and of the *H. bostrichus*. The cray-fish (*Astacus fluviatilis*) is found in all the lakes and rivers of southern and central Finland.

Section B.—Game and Game Laws.

In most countries in Europe the Chase, or Game and the Game Laws, is associated not only in the popular conception, but in the national legislation, with Forestry; and to this subject the Commissioners appointed in 1865 to enquire into all matters pertaining to the forests of the country gave their attention, and made it a subject of their report.

The Game Law of Finland, issued under date of 10th February 1868, classifies all animals in a wild state, according as they may be more or less useful or noxious, under three categories, namely:—1. Useful game, the reproduction of which is assured by the prohibition of killing them during a specified period of each year; 2. Noxious beasts, and birds of prey, the destruction of which is encouraged; 3. Other game, the destruction of which is permitted, but not specially encouraged. In the first class is comprised game, properly so called, which serves for food. The pursuit of this is prohibited for a specified time—in general, from the 15th of March to the 9th of August. The law prohibits absolutely the hunting of the beaver, which seems now to have disappeared from Finland, and that of the elk, which is becoming more and more rare. On the other hand, the destruction of noxious animals—bears, wolves, the lynx, the glutton, martens, eagles, goss-hawks, ospreys, is expressly recommended; it is permitted at all seasons to hunt them, both on the grounds belonging to the hunter and on grounds belonging to others, but always under this condition in the latter case, that the hunter shall compensate all damage done by the hunt to cultivated fields, enclosures, and plantations. All the communes grant a money

premium to the hunter who destroys one of these animals. Notwithstanding this, the carnivori—especially the bears and the wolves—still commit every year ravages on the flocks and herds.

The following statistics, drawn from official reports, may be interesting:—

Domestic animals killed by wild beasts—

	1861-1865.	1866-1870.
Horses and Colts,	1925	1802
Horned Cattle,	6129	5584
Sheep and Goats,	15,323	14,061
Swine,	1807	1400
Reindeer (in the Government of Uleaborg),	4757	2714

In the subsequent five years, 1871–1875, the four Governments in the south lost in this way—

1008 Horses,
3894 Horned Cattle,
9265 Sheep and Goats; and
791 Swine.

There are no official notices of losses in the northern provinces, but it is reckoned that these would not be less considerable. It is reckoned from the data given that the damage done in this way must amount to at least 120,000 marks a-year.

Within the same period there were killed of beasts of prey the following numbers—

	1861-1865.	1866-1870.	1871-1875.
Bears,	613	424	421
Wolves,	2379	1553	1862
Lynxes,	191	229	433
Foxes,	9872	10,590	12,390
Martens and Ermines,	52	—	1
Gluttons,	239	114	195
Otters,	47	5	72
Beasts of prey not specified,	—	2060	—

Of course there is a great abundance of game in many of the districts of Finland, but up to the present the pursuit

of it has scarcely ever been followed otherwise than for sport, or as an accessary industry. The exports are confined almost exclusively to Russia and to Sweden. Preserved specimens sent to the Exhibition of Paris in 1867 were highly appreciated, and it is considered that preserved game might be made a lucrative article of commerce. The following were the exports, in the years specified, of birds, in so far as shown by Custom-House returns.

	1874.	1875.	1876.
Heathcocks, Small Grouse, Woodcocks, and other Birds, -	117,025	109,809	41,048
Down and Feathers (kilog.), -	11,067	3,528	2,312
Squirrels' Skins, - - -	90,588	28,430	45,740
Hare Skins, - - - -	42,020	41,946	22,173
Fox Skins, - - - -	5,370	10,434	10,854
Skins of Animals not specified, -	33,361	151,149	32,794

In regard to these numbers it is stated by Dr. Ignatius that they comprise only what were entered at the Custom-House, and that the greater part of the game killed is taken away by travellers amongst their luggage.

In several countries fishing in lakes and rivers is connected with hunting, and both committed to the surveillance of the Forest Administration.

CHAPTER V.

CLIMATE.

From the information communicated in regard to the distribution of different herbs and trees, indigenous and introduced, some general idea may be formed of the climate of different zones of the country; but more explicit information on this subject may be desired. While I was Lecturer on Botany in the University of King's College, Aberdeen, I was visited on one occasion by an old friend, a man of science, from Poland, Dr Bielioblotsky, who had applied to me for information in regard to the climate of Aberdeenshire. In stating in conversation what he was desirous of knowing, he said: 'I have already seen that *Ulex Europaeus* (the furze or whin) flowers and fruits, and I know from this that the temperature must seldom if ever fall below such and such a degree of Fahrenheit; and I have seen that the walnut produces only abortive flowers, from which I know that the aggregate heat of summer cannot amount to such and such a measure, but that is all I know. I desire to know a great deal more.' So may the traveller through Finland learn not a little in regard to the climate of the country from the state of the vegetation, but desire to learn much more.

The following information was supplied by observers in Finland who have given attention to the subject. The climate is somewhat severe, but healthy. In a land of so great an extent—the southern part in winter has five hours of daylight, and in the north there is only a slight twilight—the temperature must vary greatly. In the southern country the winter begins in the middle of November—often not till later—and it ends in April; but

in the northern parts the snow falls in the beginning of September, and disappears only in the beginning of June. For reasons which will at once suggest themselves, the climate on the coast is more mild and more equable than it is in the interior of the country—the winter less severe, the summer more cool, the autumn and the spring more prolonged and variable. The times at which the ice on the rivers and lakes breaks up has not changed much in the southern part of the country. In the districts of Helsingfors and Borga for a number of years there has been no change, while to the east it has been later, and to the west somewhat earlier, in breaking up. In the sea the ice is often floating about so late as June, and blocks up the narrow channels. A north-west wind delays the appearance of summer, the east wind is characterised by damp, the south-west wind by warmth.

The warmest place in Finland is the town of Abo, where the medium temperature in winter is —5° 7′ Celsius, while in Helsingfors it is —7° 2′ Celsius, and in Tornea it is —17°. The highest temperature throughout the country in summer is 30° Celsius in the shade. In February 1844, which was one of the severest winters in Finland, the thermometer sank in Helsingfors to—37°, and in Uleaborg it was three successive days below the freezing point of mercury. In Helsingfors, the climate of which, according to the observations of Professor Hällström, is one of the most steady and regular observed anywhere, there are annually 93 clear days, 83 half clear, and 189 cloudy. In Abo there are 103 clear, 109 half clear, and 153 cloudy.

In the course of the last hundred years the climate has become perceptibly milder, and if it can be shown that there is a periodical alternation of warm and cold days, it can be shown that the cold does not destroy the fields so frequently as formerly. The drying up of many swamps, the increased cultivation of the soil, and the destruction of the woods, have all had a beneficial influence on the climate.

The following more explicit information is supplied by

Dr. Ignatius, preceded by the remark—'Finland enjoys a mild climate relatively to its latitude.'

'The isothermal line of zero, or the freezing point, on the average temperature, passes well to the south of 60° N. lat. in the greater part of the countries in the Northern Hemisphere. In North America this line describes a curve from near the island of Aleaska, 59°, to the south part of Labrador, 48°; in Asia it approaches the southern frontier of Siberia, and reaches the Pacific to the south of the mouth of the Amonso, towards the 50th degree of latitude. In Finland, on the contrary, the isothermal line begins at the 66th degree of latitude, rises rapidly to the north, describing a curve which takes in the high land of the interior, and enters the Gulf of Bothnia, and the Frozen Ocean, in such a way that not only the countries situated to the south of this parallel, but even those which slope towards the Frozen Ocean, and experience effects of the warm current of the Gulf Stream, have a mean temperature above the freezing point. Of all the countries situated in the same latitude as Finland, the Scandinavian peninsula alone has a milder climate. Russia in Europe, on the other hand, is much more cold. The isothermal line of + 2° centigrade passes in Finland by the Government of Wasa and of Kuopio, under 64° lat., but after having entered Russia it gradually curves southward, and crosses the river Oural at 53°. Abo and Helsingfors have a mean temperature higher than that of Samara and Orenburg in 52° 30′ and 54° 50′. At Abo the mean temperature of the year is + 4·6° centigrade, and at Helsingfors, according to observations made from time to time during twenty-one years, the mean temperature of these was + 4·11°. The mean temperature of the different months was—

January,	- -	6·66 deg. Cent.
February,	- -	7·89 ,,
March,	- -	3·96 ,,
April,	- -	+1·16 ,,
May,	- -	+7·66 ,,
June,	- -	+13·86 ,,
July,	- -	+16·78 ,,

August,	+ 16·06	deg. Cent.
September,	+ 10·72	,,
October,	+ 5·60	,,
November,	0·14	,,
December,	3·88	,,

'This relatively mild climate Finland owes to the seas which surround it; as these are never frozen throughout their whole extent the winds traversing them during autumn and winter come upon the country with a tepid heat, and as a matter of fact it is only by the higher temperature of winter that Finland differs from places situated more to the east under the same parallel. While the isothermal lines are almost the same for Finland as for the Governments of Archangel and Olonetz, the isochimenal lines, on the contrary, descend directly towards the south, so that Uleaborg has in winter the same mean temperature as Saratoff, and Helsingfors and Abo the same as Astrachan. We do not mean to intimate that the winters of Finland are not severe. A temperature of —30° centigrade is at Helsingfors indeed a rare thing, but it is not an extraordinary thing; and at Tornea it happens, if not every year, at least many times in every decade, that mercury freezes in the thermometer.

'There is a considerable difference between the climate of the coast and that of the interior. The coast, influenced immediately by the waters of the sea, which, heated in summer, lose slowly their high temperature, but which, once frozen, regain it slowly, and cool down warmer winds coming from the west and the south; in consequence of this the change is much less sudden on the coasts than it is in the interior. At Helsingfors, for example, vegetation is much more tardy than at Tavastehus, which is more to the north; but, on the other hand, the trees there retain their foliage much longer, and the sea is there free of ice many weeks after the lakes around Tavastehus are frozen.

'The proximity of the sea occasions also in Finland a considerable rainfall. Observations made at Helsingfors give an average of 160 days of rain per annum, and the

quantity 20 English inches. In general, aridity is less to be dreaded in Finland than excess of rain. When the crops fail, it is almost always in consequence of a cold rainy summer, which, by retarding the growth of the crops, exposes them to the inevitable frosts of autumn.

'Besides the destruction of forests in Finland by the practice of *Svedjande*, and by the accidental spreading of fires, great devastation is occasioned at times by winter tempests, which, passing like a tornado, bend to the earth the largest pines, often tearing them up by the roots, or breaking them across the trunk at some distance from the ground.

'The prevalent winds are from the south and from the south-west; the least frequent are those from the north-east.'

THE END.

[NOTE.—When this Volume was sent to press it was in contemplation to add information in regard to the population of Finland. It has been deemed expedient to publish this apart, which will be done when the proceeds of sales of this Volume may suffice to cover the expense.]

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